

DIVISION OF ENVIRONMENT  
QUALITY MANAGEMENT PLAN

PART III:

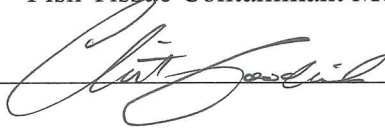
FISH TISSUE CONTAMINANT MONITORING PROGRAM  
QUALITY ASSURANCE MANAGEMENT PLAN

Revision 2  
01/03/2013

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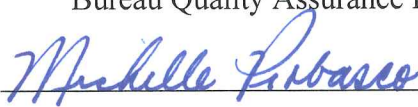
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## Section 1

### INTRODUCTION

#### 1.1 Purpose of Document

This document presents the quality assurance (QA) management plan for the Kansas fish tissue contaminant monitoring program. Quality assurance goals, expectations, responsibilities, and program evaluation and reporting requirements are specifically addressed. Standard operating procedures (SOPs) for the collection, handling, preparation, and preservation of fish tissue samples and issuance of fish consumption advisories and warnings are provided in the appendices of the plan.

#### 1.2 Basic Principles

Various trace metals, pesticides, other organic chemicals, and/or their degradation products can accumulate in animal tissues from a few to many tens of thousands of times the concentrations occurring in the ambient environment. Most organochlorine compounds, for example, are extremely stable and persist in the environment for years or decades. Toxic elements such as mercury, lead and cadmium simply do not degrade. Accumulation of these contaminants in the tissues of fish and other aquatic life occurs as the rate of uptake exceeds the rate of excretion or metabolic transformation. Exposure in fish occurs primarily via absorption of contaminants through the skin and gills or via the ingestion of tainted water, sediment, and food organisms (Topic Popovic and Strunjak-Perovic 1999).

Food web interactions in streams and lakes generally involve many trophic levels, and the successive act of eating and being eaten can result in extremely high contaminant burdens in top predatory species. The ultimate consumers of fish include predatory and scavenging birds such as the bald eagle as well as mammalian predators and scavengers such as mink and raccoons. Endocrine function disruption in predatory and semi-aquatic birds, resulting in egg shell thinning and reduced reproductive success, has been attributed to accumulation of high levels of DDT and DDT metabolites as well as other organochlorine compounds such as dieldrin and polychlorinated biphenyls (PCBs) (Hickey and Anderson 1968; Anderson and Hickey 1970; Henny et al. 2004). The near extinction of birds such as the bald eagle, peregrine falcon and brown pelican has led to reduced usage of many of the responsible chemicals (Colborn 1991; Bowerman et al. 1995; Lichter et al. 2006).

Humans are also ultimate consumers of fish and thus may be subject to elevated body burdens of long-lived contaminants as well as the potential toxic effects of these substances. Many organochlorine and metallic substances commonly detected in fish tissue are considered to be either carcinogenic or have other significant toxic endpoints (EPA 1992). Accordingly, the need for an ongoing fish tissue surveillance program is clearly indicated from a public health perspective (EPA 1995a, 1995b; KDHE 2007).

### 1.3 Historical Overview

Statewide fish tissue contaminant monitoring began in Kansas through the efforts of the Kansas Forestry, Fish and Game Commission (KFFGC), the predecessor agency to the Kansas Department of Wildlife and Parks and Tourism (KDWPT). This three year project (1971-1973) found that several organochlorine pesticides, PCBs, and an agricultural seed fungicide (hexachlorobenzene) were widely present at detectable levels in fish tissue. Fish collected from the vicinity of some large urban areas exhibited particularly high levels of chlordane and PCBs (Capel 1972; Lillie 1973, 1974).

From 1970 to the present time, the U.S. Fish and Wildlife Service (USFWS) has collected and analyzed fish from a single location in Kansas, which is the lower Kansas River at Bonner Springs (Schmidt et al. 1981, 1983, 1985; Schmidt and Brumbaugh 1990; Schmidt 2002). This sampling location was included in the USFWS National Pesticide Monitoring Program, which focused primarily on organochlorine pesticide residues. Prior to 1976, DDT and metabolites, PCBs, and dieldrin were commonly detected through this program. Chlordane detections also began increasing in frequency and magnitude during the mid to late 1970s.

The Kansas Department of Health and Environment (KDHE) collected fish samples from 12 locations across the state in 1979. These samples were analyzed for several common pesticides, other organics, and metals (e.g., chlordane, DDT metabolites, PCBs, mercury). Few contaminants were detected in either group which made the reported results somewhat questionable considering the previous and subsequent detections of these same substances.

Beginning in 1980, as a component of the U.S. Environmental Protection Agency (EPA) Region 7 Basic Water Monitoring Plan (later known as the Regional Ambient Fish Tissue Monitoring Program or RAFT), analytical support was provided to Kansas and other Region 7 states for the analysis of fish samples. Samples from seven locations in Kansas were collected by KDHE and analyzed by EPA for 123 priority pollutants and other toxics. Some contaminants were detected at all locations; however, chlordane was not detected at any location even though the analytical reporting limit for this parameter was less than that used during the earlier KFFGC and KDHE studies.

In 1982, again as part of the EPA Basic Water Monitoring Plan, fish samples were collected by KDHE from 10 locations in Kansas and analyzed by EPA for a wide variety of chemical contaminants. Many of the sampled locations were the same as in 1980. However, chlordane was widely detected and attained relatively high concentrations at several locations in the state. Additional PCB congeners and DDT metabolites were also detected and reported for the first time in Kansas.

The RAFT Program was formally initiated by EPA Region 7 in 1983. Analytical capacity allotted to Kansas allowed for the submittal of samples from 15 locations and the scanning of 17 different chemical substances. Chlordane continued to be detected at most stations and often attained concentrations more than an order of magnitude higher than those recorded for other frequently

detected organochlorine pesticides. Beginning in 1984 EPA provided, at the request of KDHE, analytical support for the analysis of three duplicate fillet samples as follow-up to locations with elevated levels of chlordane found in RAFT whole-fish samples. EPA also analyzed one set of duplicate fillet samples in 1985 and 7 duplicate fillet samples in 1986. EPA subsequently provided approximately 30 fillet analyses per year for follow-up and screening purposes.

From 1984 through 1993, the RAFT Program whole-fish sample allotment ranged from 22-26 samples per year. In 1987, KDHE collected composite fish samples on behalf of EPA for the "National Study of Chemical Residue in Fish" (EPA 1992). In 1994, EPA support for whole-fish screening and long-term monitoring was scaled back to nine samples every two years. This was a significant change, in that most of the locations of the 12 fish consumption advisory/warnings issued in December 1993 were previously discovered through the RAFT Program screening process.

From 1986 to 2004, the KDHE Health and Environmental Laboratory (KHEL) also participated in fish tissue surveillance efforts by analyzing 8-36 fillet samples for technical chlordane each year. Initially, with sample collection support provided by KDWPT, this effort focused on longitudinal changes in fish tissue chlordane levels in the Kansas River and documented a strong correspondence between urban areas and elevated levels of chlordane in fish tissue (Arruda et al. 1987). KHEL analyses also were used to confirm and augment the results reported by EPA and to provide sufficient data to derive a reasonable estimate of the "true mean or median" level of contamination allowing specific waterbodies or stream reaches to be delineated for fish consumption advisories. Due to concerns about the high PCB levels recorded at some sites, KHEL added seven arochlors to the suite of fish tissue analyses. In 2004, a problem with PCB contamination in the KHEL laboratory resulted in the temporary suspension of fish tissue analyses at this facility.

During the past decade (1999-2009), technical chlordane levels in whole-fish sampled from RAFT sites have exceeded the National Academy of Science guideline (0.1 mg/Kg, wet weight) for the protection of predators and scavengers of aquatic life. The potential for reproductive effects in native aquatic life is unclear but probably significant.

Since the suspension of the registration for chlordane in 1988, at most long term monitoring sites, statistically significant declines in the contaminant have occurred. Although chlordane concentrations in fish tissue are declining, concerns for human health may remain due to chlordane's co-occurrence with other contaminants of significance such as PCB's.

Despite the 1970's ban on the manufacture of PCB's, these compounds continue to pose human health concerns at some monitoring sites. Mercury is an emerging contaminant of concern. Beginning in 2005, KDHE has issued fish consumption advisories each year in association with elevated mercury and/or PCB levels in fish tissue. The southeast corner of the state has been heavily impacted by more than a century of mining. Lead and zinc mining was discontinued in the 1970's, however coal mining is still an active industry in the area. Analyses of river sediment, native

mussels and asian clam tissues has resulted in an advisory against any human consumption of shellfish (mussels, clams, and crayfish). Gunpowder manufacturing was also an active industry in Cherokee County, which resulted in elevated perchlorate contamination of Horseshoe Lake. KDHE does not recommend the consumption of any aquatic life from this lake based on water column levels of this contaminant.

In 2009 the FTCMP considered the adoption of a newly available fish tissue protocol made available by the EPA region 7. The new protocol utilized small (5 mm) fillet tissue plugs extracted from individual fish. The method appeared to have many potential advantages over traditional multi-fish composite fillet samples. The most intriguing potential advantage was that the results of mercury analyses would be available for the individual fish within multi-fish samples. Previously, only on occasion were individual fish analyzed due to the large volume of tissue required for an analysis and the limited ability of EPA region 7 laboratory staff to process (homogenize and subsample) large volumes of fish tissue. Other advantages included the option of collecting and packaging samples in the field, reduced processing/packaging time in the laboratory when utilizing frozen fish, and many data analysis advantages over traditional multi-fish composite samples. In 2010 EPA Region 7 delivered their fish tissue plugging protocol, QA plan, and plug data from samples collected in the Kansas City area. KDHE examined the protocol, QA measures, and data quality all of which were determined to be sound and of great potential utility. During the summer of 2010 FTCMP staff received protocol training from the EPA region 7 RAFTM coordinator. FTCMP staff independently implemented the EPA protocol beginning in 2011. The protocol was subsequently officially adopted, with some minor modifications, into the FTCMP QAMP in 2013.

In July 2012 a reorganization of the Division of Environment moved the Fish Tissue Contaminant Monitoring Program to the newly formed Watershed Planning, Monitoring and Assessment Section (WPMAS) within the Bureau of Water (BOW) as part of the Monitoring and Analysis Unit.

Currently, fish samples are collected by KDHE, KDWPT, and EPA on an annual basis from 50 or more fixed stations and rotating (i.e., screening) stations utilizing targeted, census, and probability based sampling designs (Table 1.3-1). This work continues to be supported with analytical support from EPA Region 7, provided under the auspices of the RAFT program. Each year analytical support from the EPA Region 7 laboratory includes 50 organic samples (e.g. pesticides) and at least as many inorganic samples (e.g. metals).

Table 1.3-1. Fish tissue contaminant monitoring program, subprograms summary.

SUB-PROGRAM	MONITORING DESIGN	TISSUE TYPE	# COMPOSITE SAMPLES/SITE	TROPHIC LEVEL	ANALYTES	TOTAL # SITES	TOTAL # SAMPLES	FREQUENCY
TREND (TRN)	targeted representative/census	whole-fish	1	bottom feeder	App. D, all	8	8	biennial (2yr rotation, some each year)
STATUS (STA) CLASS A LAKES	census	fillet plug	2	predator bottom feeder	App. D, metals App. D, all	17	up to 34	biennial (2 yr rotation, half each year)
STATUS (STA) CLASS B LAKES	probability	fillet plug	2	predator bottom feeder	App. D, metals App. D, all	5	10	annual
STATUS (STA) LARGE RIVERS	targeted representative	fillet plug	2	predator if available or bottom feeder	App. D, metals App. D, all	as needed	as needed	as needed
WADEABLE STREAMS (WAS)	probability	fillet plug	2	predator if available or bottom feeder	App. D, metals App. D, all	15	up to 30	annual
ADVISORY FOLLOW-UP (ADV/FOL)	targeted	fillet plug	2	predator if advisory for metals or bottom feeder	App. D metals App. D, all	as needed	as needed	annual
INTENSIVE FOLLOW-UP (FIS)	targeted	fillet plug	2	predator and/or bottom feeder as dictated by concern	App. D metals App. D, all	as needed	as needed	as needed

Census = all sites sampled; Targeted= site selection directed by previous sampling or known water quality problem; Targeted representative = site selected to represent larger reach or stream as a whole (usually located in downstream reaches to serve as watershed integrator sites); Probability = unweighted, spatially balanced, random selection based on the population of streams and lakes included in Kansas surface water register.

Data obtained through this collaborative effort are used to evaluate various waterbody types for environmental trends, aquatic life support, and human health significance of contaminants in fish.

#### Trends (TRN)

The trend subprogram is comprised of a targeted representative/census sampling design and currently consists of eight long-term whole-fish monitoring sites located on major rivers. These monitoring sites are utilized to track changes in fish contaminant levels through time and to evaluate risks to piscivorous wildlife. Sites are currently sampled every other year. Most of these monitoring sites are located in the most downstream reaches of main stem rivers, serve as watershed integrators, and are considered to provide a level of census for some of the state's largest streams. The target species for trend sampling is the common carp, *Cyprinus carpio*, because of its ubiquitous and abundant nature in Kansas waters and its bottom feeding habit (EPA 1994). Other bottom feeding fish (e.g., members of the sucker or catfish families) may be substituted. The analyses are conducted on composites of 3 to 6 whole-fish. Analytes include all parameters in Appendix D.

#### Status (STA)

The status subprogram is primarily a screening component either intended to evaluate new water bodies for tissue contaminants of human health significance or to update the status of water bodies where information may be dated or need to be kept current because of the recreational significance of the waterbody. Historically, the sampling design has been targeted. KDHE and EPA personnel sampled streams and rivers while support for lake sampling was provided by KDWPT. Currently, the sampling design is census based for 17 of the largest and most significant lakes in terms of angling use and fish harvest. These 17 Class A lakes are sampled on a two year rotation. The remaining lakes on the Kansas Surface Water Register are considered Class B lakes. Class B lakes number more than 300 and are sampled under a probabilistic monitoring design. The initial goal was to collect samples from 15 Class B lakes per year, however this was scaled back to 5 lakes per year because of logistical and coordination issues related to the complexities of the multiagency effort. Samples consist of 3-6 fish composite fillet samples and/or tissue plug samples from 3-6 fish. Predators are preferred for assessment of metals and bottom feeders are preferred for the assessment of organic parameters listed in Appendix D.

#### Advisory Follow-up (ADVFOL)

An attempt is made to collect replicate samples from all fish consumption advisory sites on an annual basis. This targeted sampling is conducted to provide data for risk assessments conducted on an annual basis or as data are available. Samples consist of 3-6 fish composite fillet samples and tissue plug samples from 3-6 fish. Predators are preferred for assessment of metals and bottom feeders are preferred for the assessment of organochlorine contaminants listed in Appendix D.

## Wadeable Streams (WAS)

Beginning in 2006, 15 probabilistic wadeable stream sites have been sampled annually. It is anticipated that within a 4-year cycle the fish tissue quality of wadeable streams in Kansas will be ascertained with a known degree of statistical certainty. Although definitions of wadeable streams vary geographically, KDHE considers most of the stream miles in Kansas to be wadeable with the exception of the lower-most reaches of some large rivers, which are censused under other subprograms such as Status or Trends. Samples consist of 3-6 fish composite fillet samples and tissue plug samples from 3-6 fish. Predators are preferred for assessment of metals and bottomfeeders are preferred for the assessment of the organic compounds in Appendix D.

## KDHE Fish Tissue Contaminant Intensive Survey (FIS)

The FIS subprogram was first implemented in 1986 to evaluate chlordane and PCB levels in fish tissue. These analyses were performed by KHEL. The goals of the program were twofold:

- 1) Identify waterbody segments exhibiting fish tissue chlordane or PCB contaminant levels of potential human health significance for the purpose of delineating "safe" segments and those requiring consumption advisories or warnings; and
- 2) to confirm results from the EPA Region 7 laboratory in cases where preliminary data indicate the potential for fish tissue contamination of human health significance

From 2004 to present, all analyses have been performed by the EPA Region 7 laboratory. The FIS subprogram is now utilized to perform follow-up fish sampling and analyses for waterbodies of concern identified through the other sub-programs. Special studies are also conducted under the auspices of FIS subprogram, especially studies related to mercury contamination. Sample may be whole fish composite, fillet composite and/or tissue plug samples depending on study needs.

### 1.4 Contemporary Program Objectives

The fish tissue contaminant monitoring program endeavors to track concentrations of potentially toxic chemical substances in the tissues of selected, widely distributed fish species and popular game fish species. Information obtained from this program is used to characterize the environmental and public health risks associated with the presence of these chemical substances. Specific programmatic objectives include:

- (1) the development and annual review and revision of the Kansas list of fish consumption advisories and warnings for human consumers of locally-caught fish;
- (2) the identification of publicly owned (or publicly accessible) waterbodies wherein contaminant levels in fish pose an unacceptable risk to the survival and propagation of predatory and scavenging wildlife species;

- (3) fulfilling the water quality monitoring and reporting requirements of 40 CFR 130.4 and sections 106(e)(1), 303(d), 305(b), 314(a) and 319(h) of the Clean Water Act;
- (4) documenting spatial and temporal trends in fish tissue contaminant levels resulting from residential pesticide usage, changing agricultural and industrial practices, and other factors;
- (5) developing scientifically defensible environmental standards and waterbody/watershed pollution control plans; and
- (6) evaluating the effectiveness of pollution control efforts and waterbody remediation and restoration initiatives implemented by the department and other natural resource agencies.

Emerging contaminant issues will be addressed as laboratory capability is improved. Flame retardants (PBDEs) and dioxins as well as contaminants such as antibiotics, hormones and pharmaceuticals are among the most significant of the emerging concerns and have both environmental and human health implications.

## Section 2

### QUALITY ASSURANCE GOALS

The foremost goal of this QA management plan is to ensure that the fish tissue contaminant monitoring program produces data of known and acceptable quality. "Known quality" means that data precision, accuracy, completeness, comparability and representativeness are documented to the fullest practicable extent. "Acceptable" means that the data support, in a scientifically defensible manner, the informational needs and regulatory functions of the Bureau of Water, the Division of Environment, and the agency. The success of the program in meeting this general goal is judged on the basis of the following quality control (QC) performance criteria and requirements:

- (1) Where practicable, the precision of the program data shall be documented in a quantitative fashion. For individual contaminants, the precision of the data shall be evaluated via replicate sampling activities conducted by field staff. Relative percent difference (RPD) is used to assess replicate comparability. Replicate composite samples are expected to exhibit an RPD, on average, of less than 50 percent.
- (2) Systemic laboratory bias and analytical precision and accuracy are evaluated internally by the EPA Region 7 laboratory. All analytical results are accompanied by documentation explaining any laboratory bias or departures from acceptable precision and accuracy. This documentation is reviewed by the program manager and detailed in the annual year end QA/QC report.
- (3) Loss of fish tissue data due to specimen collection, transport or storage problems, or to the subsequent mishandling of data, shall be limited to less than two percent of the data originally scheduled for generation. If problems occur and a substantial quantity of data is lost, an effort shall be made to resample the affected waterbody to maximize data completeness.
- (4) Changes in the methods used to obtain and analyze fish tissue samples shall be carefully documented through formal revisions to the SOPs appended to this QA management plan. This requirement is intended to help maintain a reasonably consistent database over time, enhance knowledge of the effects of any procedural changes on reported contaminant levels, and facilitate the identification and evaluation of long-term trends in contaminant levels.
- (5) Data generated through this program shall be compared and contrasted with other available monitoring information to examine the representativeness of program findings relative to other reported results. Staff shall attempt to ascertain the probable causes of any discrepancies observed between the various existing databases and

describe, in end-of-year program reports, the magnitude and practical significance of such discrepancies.

### Section 3

## QUALITY ASSURANCE ORGANIZATION

### 3.1 Administrative Organization

The general administrative structure of the fish tissue monitoring program is depicted in Figure 3.1-1, below.

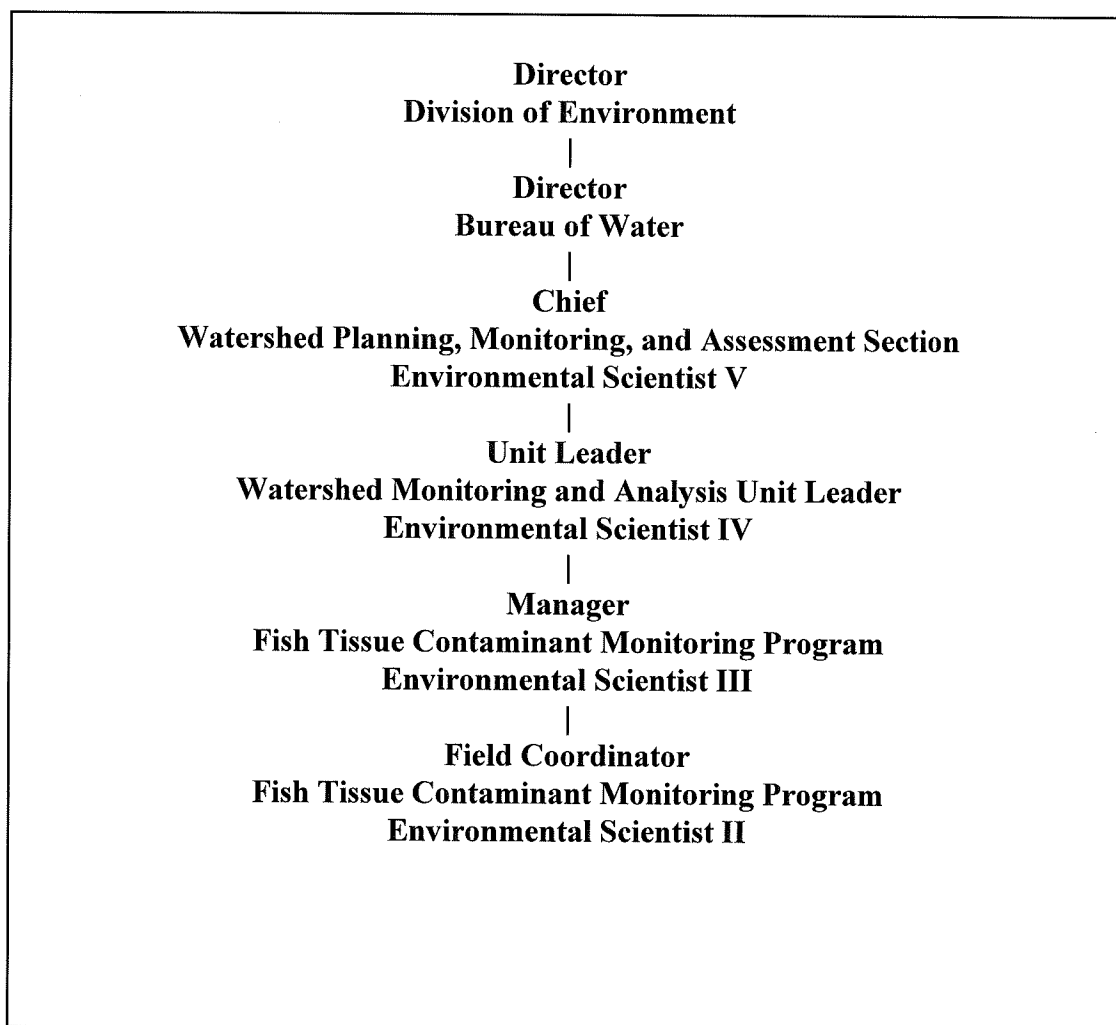


Figure 3.1-1. Administrative hierarchy of fish tissue monitoring program

### 3.2 Staff Responsibilities

The fish tissue contaminant monitoring program is administered by the Bureau of Water (BOW), one of five bureaus within the KDHE Division of Environment. Although program planning, sample collection, equipment inventory and maintenance, sample preparation, laboratory submission, data entry, data analysis, risk assessment, and consumption advisory formulation are implemented primarily by program staff, KDWPT provides sample collection support, advisory review and concurrence as well as advisory communication. Additional sample collection and sample preparation support is provided by EPA Region 7 staff on an as needed basis. Sample laboratory preparation, analysis, laboratory QA/QC, and data reporting are the responsibility of the EPA Region 7 laboratory.

Program staff include two environmental scientists, both affiliated with BOW. The program manager (Environmental Scientist III) is directly accountable for program planning, implementation, data interpretation, advisory formulation, and QA/QC. The manager also formulates year-to-year sampling priorities; supervises the program's Environmental Scientist II, identifies personnel, budgetary and training needs, allocates available resources (e.g., sample allotments) among the various subprograms (Table 1.4.1), determines priority sampling locations and analytic parameters, interprets data and conducts risk assessments, and coordinates with participating outside agencies and the general public regarding advisories.

The field coordinator (Environmental Scientist II) is responsible for the day-to-day scheduling of field sampling activities, the identification of specific localities for sample collection, coordinating with other agencies involved in sample collections, supervising temporary crew members, participating in sample collection and/or sample packaging and labeling; collection of ancillary data, fillet preparation, completion of field collection and chain-of-custody forms, and transporting samples to KHEL and EPA Region 7 laboratories for analysis. Personnel from other BOW monitoring programs assist in electrofishing and other fish collecting activities as requested by the program manager and directed by the section chief. Staff of the fish tissue contaminant monitoring program provide reciprocal assistance to these monitoring programs, as needed.

### 3.3 Staff Qualifications and Training

Minimum technical qualifications for program staff vary by position. The program manager must hold at least a four-year college degree in aquatic biology or a closely related scientific field and have substantial experience in the performance of water quality studies and associated data analysis and statistical procedures. The program manager must also understand the basic principles of supervision, program administration, and quality control and possess advanced computer skills and written and oral communication skills. Also, pursuant to Part I of the divisional quality management plan (QMP), the program manager must complete formal supervisory training offered by the Kansas Department of Administration and quality assurance training offered by EPA. The program's environmental scientist II must possess a strong taxonomic familiarity with the fishes occurring in

Kansas. He/she must also command a thorough understanding of the procedures used in electro-fishing, the preservation and labeling of fish tissue specimens, and the processing of associated paperwork and other documentation.

All individuals routinely participating in this program must possess a valid Kansas driver's license and current certifications in first aid, cardiopulmonary resuscitation (CPR), and Automated Electronic Defibrillation (AED). They must review the program's QA management plan and SOPs prior to assuming field/laboratory duties and repeat this review at least annually (QMP, Part I). All program staff receive in-house training in applicable work procedures and related safety requirements. As funding and other agency resources allow, the program manager and the environmental scientist II are encouraged to participate in technical workshops and seminars dealing with environmental monitoring operations and related field, analytical, data management and statistical procedures.

## Section 4

### QUALITY ASSURANCE PROCEDURES

#### 4.1 General Overview

Considerable variation in individual fish tissue contaminant levels may be present at a given location and point in time. Differences may be seen in contaminant levels between fish species with different feeding modes, life histories, or differing physiologies. Within a species, differences may be seen among age classes and between individuals with differing histories of exposure to bioaccumulative contaminants. Control of these variables reduces sample-to-sample and year-to-year variation in contaminant levels and provides a more accurate estimation of the mean or median concentrations of the monitored contaminants. Samples are typically collected as composites of 3-6 fish of the same species and preferably of the same age class. The smallest fish in a composite sample should be at least 75 percent the length of the longest fish.

The objectives of the particular sub-program for which the fish are collected dictate the specific numbers, species, and sizes of fish to be collected from a given waterbody as well as the tissues and parameters of interest. Fish are submitted for analysis as whole-fish, fillets (edible portion), fillet plugs, or specific tissues. Whole-fish are analyzed to detect the presence of the widest variety of pollutants. These analyses achieve greater sensitivity for some contaminants than the analysis of fillet samples. Fillets and/or fillet plugs are analyzed if the objective of the study is to determine the presence of specific pollutants in the edible portions of fish that could pose a potential risk to human consumers (EPA 1989, 1994, 2000). KDHE considers the term "fillet" to be synonymous with the term "edible portion" and does not include skin or scales in the definition. Rarely, specific tissues (e.g., liver, kidney, sex organ, brain, bone, skin) are analyzed when the objective of the study is to determine the presence of specific toxicants known to accumulate in certain organs of the fish, or to determine if specific pollutants accumulate in certain organs of the fish.

Contaminant concentrations in fish typically increase with age. Within a given species of fish, length and/or weight may be acceptable surrogates for age. Because the evaluation of potential human exposure to contaminants may require knowledge of the relationship between fish contaminant burdens and fish age or size class, the weight (nearest 10.0 grams) and length (nearest 0.5 centimeter) of each fish collected for analysis are measured and recorded. For the purpose of this program, the weight of the fish means the total weight of the whole-fish prior to any processing. The length of the fish is defined as the total length of the whole-fish as measured from the tip of snout to the tip of the tail.

Standard operating procedures for all field and laboratory aspects of the fish tissue contaminant monitoring program are found in Appendix B.

#### 4.2 Monitoring Site Selection Criteria

The objectives of the subprogram for which fish are being collected will determine the placement of sampling locations or stations within a specific waterbody. Chosen sites typically reflect: (a) key locations in waterbodies which are of critical value due to angling pressure, fish harvest, and proximity to population centers; (b) waterbodies of special importance to propagation and maintenance of fish and aquatic life; (c) locations in major water bodies potentially subject to inputs of contaminants from areas of concentrated urban, industrial, or agricultural use; and (d) sites chosen using a probabilistic (random) selection process (e.g. WAS and Class B components of the STA subprogram).

The sampling reach in a stream or the sampling area in a lake is defined in terms of distance from an entry point into the waterbody. Stream sites are defined as one-half mile upstream or downstream from a specified entry point. Lake sites are defined by a one-half mile radius extending into the lake from the entry point at the shoreline. Adherence to the defined sampling reach or area serves to reduce sample variability which could result from localized contaminant sources or structures that limit fish movement and isolate populations (e.g., dams, lowhead dams, diversion jetties).

Appendix B (FTCMP-002, SBMP-006) describes procedures for delineating sampling sites and for recording site locations with a Garmin GPIII+ or V hand-held global positioning unit. Historically, other GPS equipment or U.S. Geological Survey. 7.5' topographic maps were used for this purpose. They remain acceptable alternative means of recording site locational data.

#### 4.3 Sample Collection, Handling, Preservation, Fillet Preparation and Chain-of-Custody Procedures

Sample collection may be accomplished by a wide variety of means commonly used by ichthyologists and fisheries managers. KDWPT employs a variety of methods including electrofishing and various kinds of nets and traps for collection of fish samples. KDHE primarily uses electrofishing methods; however, common carp samples may be collected from deep water by hook and line. While engaged in fish sample collection, KDHE staff must maintain in their possession a valid KDWPT- issued scientific collecting permit.

Operation of all types of electrofishing equipment is fundamentally similar. The primary difference among the three types of electrofishing devices (back-pack, tote-barge and boat) is simply the amount of power (watts) which can be applied and the range of the resultant effective electrical field. To prevent fish avoidance of the electrical field, electrical current normally should be applied intermittently in open water, and only upon closely approaching likely fish habitats. Captured fish are placed in mesh holding bags and suspended in the water (lake or stream) from which they were collected. Tote-barge and boat electrofishing rely on the use of gasoline powered generators; thus, care must be taken to avoid any contamination of collected samples with gasoline, oil, or generator exhaust fumes.

Fish comprising a composite sample are wrapped individually in extra-heavy duty aluminum foil (shiny side out), bundled together with strapping tape, labeled, and placed in clean plastic bags. Samples must be frozen rapidly on dry ice or held on wet ice no longer than 12 hours before placing in a freezer, where they should be held at -20° Celsius.

Samples intended for human health risk assessment are submitted to the laboratory as fillets or fillet plugs. Fillet and most fillet plug samples are prepared in a clean laboratory environment. Fillet plug samples may be prepared in the field following FTCMP-005. Samples are partially thawed in the original aluminum foil packaging, then filleted or plugged on fresh clean aluminum foil over a clean stainless steel counter top. Fillets come into contact with only fresh, clean aluminum foil and clean stainless steel fillet knives. Fillet plugs come into contact with only fresh, clean aluminum foil, clean stainless steel scalpels, clean stainless steel punch biopsy tools, and clean glass scintillation vials whether processed in the laboratory or at a field sampling site.

Samples must remain in the possession or control of the program manager or field coordinator pending shipment to the laboratory. Normally, samples transferred from the field are placed in a locked chest freezer maintained in a locked laboratory with emergency back-up power.

Sample collection, handling, preservation and chain-of-custody procedures are discussed in detail in SOPs FTCMP-002 and FTCMP-003 (Appendix B).

#### 4.4 Safety

Attention to job safety protects the health and well-being of program staff and helps maintain a work atmosphere which ultimately enhances data quality and consistency. Program staff must be familiar with proper precautionary measures and the use of available safety equipment prior to assuming field duties. All field staff must be certified in adult cardiopulmonary resuscitation, the use of automated external defibrillators (AED), and basic first aid by the American Red Cross or an equivalent institution. All vehicles routinely used in the fish tissue contaminant monitoring program must be maintained in proper condition and equipped with first aid kits, AED, emergency eye wash bottles, fire extinguishers, spare tires and tire changing equipment, rain gear, road reflectors and/or flares, and operable flashlights. Before leaving for the field, monitoring personnel are expected to carry a personal cellular phone or check out a cellular phone from BOW clerical staff to use in the event of a vehicle mishap, medical problem, or other emergency. Access to a cellular phone is particularly important when traveling alone, conducting overnight sampling runs, or traveling during periods of potentially severe weather.

Handling of equipment when some degree of heavy lifting is required necessitates distribution of the weight load among crew members and use of correct lifting posture (i.e., lift with the legs rather than the back). Often, loading and unloading equipment requires traversing steep, irregular or slippery banks, boat ramps, or dock surfaces. Electrofishing requires considerable caution and

preparation on the part of the field crew. Thorough familiarity with the electrical equipment's operating parameters and safety cutoffs is essential.

Electrofishing must not be attempted or continued in the event of significant wetting rain, lightening, thunder, or rising water and increasing currents. Additional safety considerations are detailed in the SOPs accompanying this QA management plan (Appendix. B., FTCMP-002, SCMP-002).

#### 4.5 Analytical Procedures

All EPA Region 7 laboratory analyses are conducted in accordance with Region 7 EPA SOPs and EPA- approved analytical methodology (mercury by atomic absorption spectroscopy: Method 3121.23B; metals by inductively coupled plasma emission spectroscopy: Method 3122.03C; pesticide extraction: Method 3210.3E; pesticide analysis by gas chromatograph electron capture detector : Method 3240.02H).

#### 4.6 Data Validation, Storage, Transfer, Backup

Data validation is accomplished initially through EPA Region 7 laboratory internal QA/QC measures including analysis of standards, matrix spikes, blanks, and duplicates. Data from duplicate field samples are compared to each other and available historical data to identify anomalous or suspect values relative to recent historical results and trends.

Fish tissue data generated by the EPA laboratory are uploaded to the EPA STORET environmental data storage and retrieval system maintained by EPA. KDHE reviews the EPA generated data to ensure the accompanying metadata (e.g.) sample composition, collection dates and locations are correct.

Program staff enter all fish tissue data generated by EPA into an EXCEL spreadsheet or ACCESS database for analysis and reporting. Data are visually reviewed upon entry for completeness and correctness. Summary parameters (e.g., total chlordane, total DDT, total PCBs) are reviewed to ensure the stated values are not exceeded by any components. These data are entered onto a personal computer and saved on a KDHE server hard drive that is backed up daily.

#### 4.7 Data Reporting

The food procurement use is assigned to most classified lakes and streams listed in the Kansas surface water register (KDHE 2010). Attainment of this use is routinely evaluated in the Kansas biennial water quality assessment report (Clean Water Act, section 305(b)). Waters with a current fish consumption warning (no consumption recommended) or a fish consumption advisory (limited consumption recommended) are considered non-supporting of both the food procurement use and

aquatic life support use. The absence of any fish consumption warning or advisory is construed as evidence of full food procurement use support.

Fish consumption advisories or warnings are issued on an annual or as otherwise needed. Most are issued near the beginning of the calendar year through a joint KDHE/KDWPT press release, published in the brochure, *Kansas Fishing Regulations*. An online version of this publication is posted on the KDWPT fishing webpage (<http://www.KDWPT.state.ks.us/news/Fishing/Are-My-Fish-Safe-To-Eat>) and the KDHE, BOW, Watershed Planning Section and fish tissue contaminants monitoring program webpage ([http://www.kdheks.gov/BOW/fish\\_tissue\\_monitoring.htm](http://www.kdheks.gov/BOW/fish_tissue_monitoring.htm))

#### 4.8 Equipment Calibration and Preventive Maintenance

Periodic inspection and routine maintenance of field and laboratory equipment are necessary to minimize malfunctions which could result in the loss of data or disruption of program activities. Electrofishing equipment calibration, repair or service is conducted only by the factory or a qualified electronics technician. Annual maintenance in the form of cleaning, checking connections and operational status are conducted by the field coordinator. Routine maintenance and inspection is conducted by the field coordinator prior to each use. The program manager also inspects equipment periodically both prior to and during use.

Other sampling equipment, such as dipnets, holding bags, jon boat, boat tie down ropes and chest waders, must be inspected periodically and repaired or replaced if necessary. Vehicles used during field activities also must be maintained in a reliable condition. Entries must be made in the vehicle log upon completion of each field trip. All vehicle malfunctions and accidents must be reported to the appropriate supervisor (i.e., program manager, section chief) as soon as possible to expedite necessary repairs or the acquisition of a replacement vehicle.

Detailed SOPs addressing the operation and maintenance of electrofishing equipment and vehicles are found in Appendix B (FTCMP-003, SCMP-002).

#### 4.9 Procedures for Evaluation of Data Accuracy, Precision, Completeness, Representativeness and Comparability

A large proportion of the analyses of fillet samples are conducted on duplicate samples, i.e., samples of comparable composition in terms of species of fish, number of individuals in composite, and size of individuals in composite. Duplicate sample results are evaluated to provide a measure of combined sampling and analytical precision.

EPA Region 7 Laboratory conducts internal QC evaluations of their sample handling, processing, and analytical procedures. Data reported by this laboratory includes an explanation of any QC issues encountered for each analytical service request (ASR), including individual parameters whose QC

measures were out of control (e.g., laboratory duplicates, blanks, and spikes), and any procedural or preservation mistakes made by the laboratory personnel, and any equipment failures. Samples and/or parameters for a particular ASR (one ASR per subprogram per year) affected by QC problems are appropriately flagged (coded) and explained by the Region 7 laboratory. QC coded data and explanations are included with the raw data transferred to KDHE. Codes are retained as the data are transferred to the fish tissue database maintained by the program manager. In preparation for the annual FTCMP QA/QC report, all coded data are reviewed. The response and actions taken on such data by the FTCMP manager are detailed in the annual QA/QC report. This report is subsequently reviewed and approved by the section chief prior to the data inclusion in 305 (b) reports, 303(d) lists, and fish consumption advisories or warnings.

Estimated "mean" or "median" contaminant levels in fish from a particular locality or stream reach are calculated to evaluate the human health significance of a particular contaminant. This calculation normally is based on data from multiple composite samples collected over a period of at least three consecutive years. When evaluating contaminant levels in fish for human health significance, an effort is made to collect and analyze multiple species to ensure representativeness of data for risk assessment. Data are reviewed with respect to historical findings and results from nearby sampling localities.

## **Section 5**

### **REVIEW AND REVISION OF PLAN**

To ensure that the fish tissue contaminant monitoring program continues to meet the evolving informational needs of the bureau and the agency, all portions of this QA management plan and its appended SOPs must be comprehensively reviewed by participating staff on at least an annual basis. Significant revisions to the plan and SOPs require the approval of the program manager, section chief and bureau QA representative prior to implementation. Although review activities normally follow the annual program evaluation in February, revisions to the plan and SOPs may be implemented at any time based on urgency of need or staff workload considerations.

Original approved versions of the QA management plan and SOPs, and all historical versions of these documents, are maintained by the bureau QA representative or his/her designee. The bureau QA representative also maintains an updated electronic version of the plan and SOPs on the KDHE internet server in a "read only" .pdf format.

**APPENDIX A**

**INVENTORY OF FIELD AND LABORATORY EQUIPMENT**

**FISH TISSUE MONITORING PROGRAM**

## INVENTORY OF FIELD AND LABORATORY EQUIPMENT

### I. VEHICLE

- A. Mini van (or other suitable field vehicle, as available)
- B. Vehicle registration and proof of insurance
- C. Vehicle log book (Wright Express card, list of cooperating service stations, copy of tire, battery and emergency service contracts,
- D. State highway and 1/4" scale county maps or atlas
- E. Vehicle key and spare key(s)
- F. Mobile cellular phone
- G. Fire extinguisher, first aid kit, AED, CPR mouthpieces, latex rubber gloves, paper and cloth towels, hand sanitizing solution in plastic squeeze bottle
- H. Spare tire (fully inflated), tire changing equipment, road reflectors and/or flares
- I. Tool kit, jumper cables, tow rope, windshield ice scrapers, flashlights (fully operable), fluorescent orange safety vests with reflective strips
- J. Kansas Turnpike K-Tag Pass
- K. Garmin Nuvi GPS Navigation System

### II. GENERAL FIELD EQUIPMENT

- A. Equipment/supplies routinely used in the field
  - 1. Impervious (non-breathable) chest waders (1 per crew member, 1 spare pair), and wader repair kit.
  - 2. (2) 10' aluminum jon boat tote barge
  - 3. Various motor boats including 12', 14', and 16' jon boats, and Smith Root electrofishing research vessels.
  - 4. (2) Nissan 6.0 HP outboard motors

5. (2) 12.0 liter fuel tanks
6. Rubber or lined PVC gloves (1 pair per crew member, additional spare pairs)
7. (2) Smith-Root 2.5 Gasoline Powered Pulsator (GPP) electrofisher generator
8. (2) Smith-Root 2.5 GPP electrofisher control box and electrode junction box
9. Smith-Root LR-24 backpack electrofisher
10. (2) 6' anode pole, (2) rat-tailed cathode, (2) spare 6' anode pole
11. (4) 6' nonconductive handled dip nets
12. Coast Guard approved life vests (1 per crew member)
13. (4) Oars
14. Mesh type fish holding bags (2-6)
15. Heavy duty or extra-heavy duty aluminum foil
16. Fiberglass reinforced strapping tape
17. 30-gallon plastic bags
18. 100-quart ice chests
19. Labels, indelible marker, clip board
20. First aid kit, AED
21. Hand disinfectant
22. Sample collection/submission/chain-of-custody forms
23. Pencils, Sharpies, cardboard sample tags
24. Dry or wet ice (depending on duration of sampling trip)
25. Utility Knife

26. Wire Cutters
27. Fire extinguisher
28. Garmin GPS III+

### III. FILLET AND FILLET PLUG SAMPLE PREPARATION AND OFFICE EQUIPMENT

#### A. Equipment routinely used in preparation of fillet and fillet plug samples

1. Stainless steel fillet knives (2 sizes)
2. Stainless steel countertop/sink
3. Large-pan single-beam balance (15.5 kg capacity)
4. Sharpening steel
5. Sterile disposable stainless steel 5 mm biopsy punch tool
6. Sterile disposable stainless steel scalpel
7. 20 mm glass scintillation vials
8. Pipette bulb
9. Fish measuring board
10. Chest type freezer
11. Heavy duty or extra-heavy duty aluminum foil
12. Preprinted laboratory labels
13. EPA Field Sheet and Sample Submission Form APP. C-2
14. EPA Laboratory Sample Chain-of-Custody Form APP. C-3
15. Polyethylene carboy containing deionized water

16. Bi-fold paper towels in steel wall-mounted dispenser
- B. Equipment and software routinely used in data management and reporting
1. (2) M-Tech Core 2 Duo 2.66 Ghz personal computer, 0.98 Gb RAM
  2. (1) M-Tech Core Quad 2.83 Ghz personal computer, 3.25 Gb RAM
  3. Database software: ACCESS 2003
  4. Spreadsheet software: EXCEL 2003
  5. Word processing software: WORD 2003
  6. Sigmaplot 9.0 Graphing Software
  7. Minitab 15 Statistical SoftwareQMP/III/BOW
  8. R Statistical Software

**APPENDIX B**

**STANDARD OPERATING PROCEDURES**

**FISH TISSUE CONTAMINANT MONITORING PROGRAM**

## APPENDIX B

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## MAINTENANCE PROCEDURES FOR FIELD SAMPLING EQUIPMENT (FTCMP-001)

### I. INTRODUCTION

#### A. Purpose

The following paragraphs describe the procedures used for maintenance of field sampling equipment.

#### B. Equipment and Supplies

1. Impervious (non-breathable) chest waders
2. Rubber or lined PVC gloves
3. (2) Smith-Root 2.5 GPP electrofisher generator
4. (2) Smith-Root 2.5 GPP electrofisher control box and probe junction box
5. (2) Smith-Root LR-24 electrofisher
6. Anode/cathode poles, rat-tailed cathode or boat hull cathode
7. Dip nets
8. 10', 12', and 14' jon boats
9. U.S. Coast Guard approved life jackets
10. (2) Nissan 6.0 HP outboard motors

### II. PROCEDURES

When electrofishing in waterbodies known or suspected to be infested with zebra mussels: *Dreissena polymorpha*, ALL equipment coming into contact with water, including chest waders, must be allowed to dry for at least of seven days before being used in non-infested waters.

#### A. Chest waders

1. Store waders in a hanging position in a cool, dark area to reduce cracking.

2. Repair rips or tears with silicone, aquaseal, or adhesive patches.
3. Remove mud prior to storage.
4. Maintain insides of waders in a dry condition to reduce deterioration of lining material.

B. Rubber or lined PVC gloves

1. Repair small rips or tears with aquaseal or silicone seal or replace gloves.
2. Keep insides of gloves dry to reduce deterioration of lining material.

C. Smith-Root 2.5 GPP electrofisher generator

1. Change oil on an annual basis.
2. Check oil prior to each use.
3. Empty fuel tank at the end of sampling season or fill tank and use gas stabilizer.
4. Secure all connector caps after each use.
5. Clean all connectors on an annual basis.
6. Inspect all connecting cables prior to each use.
7. Replace in-line fuel filter every 250 hours.
8. Air filter: Clean and re-oil the prefilter annually. Inspect the paper cartridge filter annually; clean by tapping on a flat surface and replace if needed.
9. Clean the cooling fins annually to prevent overheating.
10. Clean and regap the spark plug annually; reset gap to 0.030".
11. Inspect spark arrestor screen and muffler annually and replace if damaged.
12. Inspect generator brushes every two years.

13. Clean collector rings at time of brush inspection.
14. Other repairs to generator should be conducted by a factory authorized technician or competent generator service shop.

D. Smith-Root 2.5 GPP electrofisher control box and probe junction box

1. Leave control box open for several days following each use to ensure drying of any moisture acquired during field use.
2. Wipe control box panel free of dirt and water spots acquired during field use.
3. Replace all connector caps after each use.
4. Clean all connectors on an annual basis.
5. Check all connecting cables prior to each use.

E. Smith-Root LR-24 battery powered backpack electrofisher

1. Wash the exterior of the case and the suspension system with mild soap solution and dry as needed. Never use solvents to clean the LR-24.
2. Clean battery cases with a damp cloth.
3. Batteries must not be allowed to fully discharge in storage. During the off season, batteries must be charged at least every 3 months.

F. Anode poles and rat-tailed cathode

1. Clean anode ring and rat-tailed cathode with sandpaper or steel wool on an annual or an as needed basis depending on degree of mineralization.
2. Check all connecting cables prior to each use.

G. Dip nets

1. Repair insulation on handles or replace as necessary to ensure non-conductivity.
2. Repair or replace net bags before tear holes become large enough for targeted species to escape.

H. 10' aluminum jon boat tote barge, 12', and 14' aluminum jon boats

1. Inspect boat for leaks following each use and repair as needed.
2. Inspect tie-down ropes during each use and replace as fraying dictates.
3. Inspect boat trailer hitch parts for wear and functionality.
4. Inspect boat trailer tires for proper inflation and excess wear.
5. Inspect boat trailer lights for proper function.

I. Life jackets

1. Inspect life jackets prior to each use to ensure that zippers and buckles function properly and that floatation material is not water logged.

J. Nissan 6.0 HP Outboard Motor

1. Routine use inspections and procedures
  - a. Perform the following inspections prior to mounting motor on boat during sampling event:
    - i. Inspect rubber hoses for leakage.
    - ii. Check oil level, and if low, replenish with API SF, SG, SH, or SJ FCW 10W-40 motor oil.
    - iii. Insure lock plate of stop switch is present.
    - iv. Check recoil starter rope for excessive wear.
    - v. Check propeller for bent or damaged blades.
    - vi. Check propeller nut for tightness and presence of split pin.
  - b. Perform the following inspections after mounting motor on boat transom, prior to starting motor:
    - i. Check tightness of clamp screws.

- ii. Ensure safety cable is secure.
  - iii. Check turning ability of steering/tiller handle and adjust steering friction level, if needed and according to preference, by turning adjustment screw. Do not tighten excessively or damage to swivel bracket may result.
  - iv. Check throttle friction and adjust, if necessary, by turning throttle adjustment screw.
  - v. Check sacrificial anode on gear case for corrosion (>2/3 eroded) and deformation.
- c. Procedure for starting motor:
- i. Loosen air vent screw on fuel tank cap.
  - ii. Attach fuel line connector to engine connector, making sure arrow mark on fuel line primer bulb is directed toward engine.
  - iii. Squeeze primer fuel line primer bulb until bulb is firm.
  - iv. Place shifter in neutral position.
  - v. Set throttle to slow position, indicated by the turtle symbol on tiller handle.
  - vi. Pull choke knob to full choke position.
  - vii. Pull starter handle slowly until starter pulley is engaged.
  - viii. After pulley is engaged, pull starter handle quickly. Repeat until engine starts.
  - ix. After engine starts, push choke knob back to run position. In cold weather it may be necessary to set choke to half-open position until engine can run without any choke.
  - x. Allow engine to warm up for 3 minutes.
- d. After starting motor:

- i. With motor running and shifter in neutral position, check function of steering handle throttle and fuel flow.
  - ii. At idle speed, check function of clutch with shift lever to ensure both forward and reverse gears are operable.
  - iii. Check oil pressure warning lamp.
  - iv. Check function of stop switch.
  - v. Restart engine, and motor is ready for use.
2. Procedure for first use, after winter storage:
  - a. Completely fill fuel tank with 12 liters of fuel.
    - i. Do not use gasoline containing ethanol or methanol if possible. If non-alcohol fuel is not available do not use gasoline containing greater than 10% ethanol or 5% methanol.
  - b. Warm up procedure to lubricate engine and burn off storage oil from cylinder wall.
    - i. After starting engine, run engine at low speed for 3 minutes with shifter in neutral position
    - ii. Run engine for 5 minutes at lowest speed with shifter in forward position.
    - iii. Run engine at half-speed for 10 minutes with shifter in forward position.
  - c. Procedure for shutting down motor:
    - i. Approach shore/bank landing area in with motor at idle speed.
    - ii. Move shift lever to neutral position
    - iii. Moor boat securely to lake shore or stream bank
    - iv. Disconnect fuel line connector from engine.

- v. Allow engine to run (at idle speed and in neutral) until all fuel is expended.
  - vi. Turn fuel cock (on side of engine cowl) to "off" position.
  - vii. Disconnect safety cable from boat and remove motor.
  - vii. Store motor during transport in horizontal position, with steering/tiller lever facing down toward floor of vehicle.
3. Periodic (near middle of field season) inspections and maintenance.
- a. Remove spark plug and perform following inspections:
    - i. Check center and side electrodes for fouling, carbon build up, or erosion. Replace if corroded, clean if fouled.
    - ii. Check side electrode to center electrode gap. If not within 0.031 – 0.035" (0.8 – 0.9 mm), then adjust to specification.
  - b. Check fuel filter for fouling. Clean or replace as necessary.
  - c. Inspect fuel tank for dirt or other debris. Clean if necessary.
4. Maintenance performed at end of season.
- a. Take both motors to an authorized Nissan outboard motor service center for the following maintenance procedures
    - i. Engine oil replacement.
    - ii. Lower unit gear oil replacement.
    - iii. Valve clearance check.
    - iv. Lubrication of sliding and rotating parts.
    - v. Carburetor cleaning and adjustment (if necessary)
    - vi. Inspection and cleaning of water pump, and replacement of impeller.

- vii. Grease propeller shaft.
- viii. Spray storage oil in combustion chamber.

PROCEDURES FOR DEFINING A MONITORING SITE  
AND COLLECTING FISH SAMPLES  
(FTCMP-002)

I. INTRODUCTION

A. Purpose

1. Staff involved in fish tissue sample collection must adhere to a standardized procedure to maximize the potential for sample collection success and to ensure the safety of all personnel engaged in sample collection.

B. Equipment and Supplies

1. Smith-Root 2.5 GPP electrofishing equipment for tote-barge electrofishing or Smith-Root LR-24 backpack electrofisher equipment
2. Impervious chest waders or, in the case of boat electrofishing, hip boots
3. 10' aluminum jon boat or boat electrofisher operated by cooperating agency
4. Rubber or lined PVC gloves
5. Life vests
6. Mesh type fish holding bags
7. 6' or longer dip nets with non-conductive handles

II. PROCEDURES

A. Monitoring site definition

1. A sampling location or station is defined as a segment one-half mile upstream and one-half mile downstream of a specific point (usually the entry point) on a stream or river, or within one-half mile of a specific point (usually a boat ramp) on the shoreline of a lake or impoundment.
2. On a stream, the sampling area includes the entire one-mile (1.6 kilometer) segment. On a lake or impoundment, the sampling area is the 0.5 mile (0.8 kilometer) radius, roughly the equivalent to 280 acres (113.3 hectares)

in area about a shoreline point. The one mile sampling station definition assumes that there are no interferences, natural or man-made, that would impart difference in the quality of water or sediment between the specific reference point and point of collection. Potential interferences include large dams, low-head dams, and diversion jetties.

3. If it is not possible to collect fish within this one-mile (1.6 kilometer) sampling reach, the fish may be collected outside the sampling reach provided the specific location is recorded in the field notes. In order for the data generated to be representative, the distance outside the specified sampling area should be kept to a minimum.

B. Collection methods

Primary methods for collecting fish include backpack, tote barge, or boat electrofishing. Other acceptable methods include seining, trawling, angling, entanglement (e.g., gill nets, trammel nets), and entrapments devices (e.g., hoop nets, fyke nets).

1. During fish collection activities, the field supervisor (program ES III or ES II) must carry a current scientific collector's permit from KDWPT.
2. All participating field staff must abide by the terms and conditions in the KDWPT-issued collector's permit. The actual method of collecting fish at a given site will be determined by the field supervisor based on the field situation.

C. Operation of Smith-Root 2.5 GPP electrofishing unit

1. Load all electrofishing equipment into tote barge or jon boat and connect all cables between generator/control box/junction box/probes. The generator must be centered in middle portion of boat, with exhaust directed away from sampling crew. Junction box must be placed in bow of boat, in an elevated position, to prevent exposure to water that may collect in bottom of boat. Rubber foam must be inserted between generator and control box to insulate control box from generator heat and vibration. Rubber foam should be inserted between bottom of generator and floor of boat to reduce vibration, noise, and to prevent generator from sliding on boat floor.
2. Generator
  - a. Prior to start up, all switches on control box/probe junction

box/probes should be set to “off” except for the generator on/off switch.

- b. Set choke and fuel levers to the open position.
  - c. Pull starting rope to start the generator.
  - d. After initial start-up, switch off or reduce amount of choke to achieve smooth operation of the generator.
3. Control box/probe junction box
- a. Set output mode selector switch to the desired mode (AC or DC). Use only the DC mode to reduce the potential injury to non-target fish species and sampling crew.
  - b. Set percent of range to “minimum.”
  - c. Set output range selector to “low.”
  - d. Set emergency shut down switch to “on.”
  - e. Set probe junction box probe switches to “on” (toggle in the direction of the probe connector).
  - f. Close anode/cathode microswitches (if using the rat-tailed cathode, close the anode(s) microswitch(es)). The high voltage indicator light should flash or remain on.
  - g. Adjust percent of range as necessary (typically 60 to 100 percent) to achieve optimum response of fish being shocked.
  - h. Begin electrofishing with a setting of 60, 30 or 15 pulses per second.
  - i. High voltage range may be used if combination of percent of range and pulse frequency do not cause output current meter needle to deflect in excess of 3 amperes.
  - j. If erratic operation of the generator occurs when electrofishing in high voltage range, change operating parameters or use low voltage range. CAUTION: Always break the circuit when changing range. Never change range under load!

4. Use of Smith-Root 2.5 GPP mounted in jon boat tote barge for electrofishing wadeable waters
  - a. Cathode cable
    - i. When using boat as cathode, connect ring terminal at end of cathode cable to bolt at bow of boat and secure with wing nut.
    - ii. When using rat tailed cathode cable; cable must be draped over side of boat from junction box and configured so that only the rubber-coated insulated portion is in contact with boat.
  - b. Anode pole and cable
    - i. Secure anode pole cable to bow carrying handle, with clip, to minimize stress to connection at junction box.
    - ii. Anode pole operator must allow control box operator and/or other sampling personnel operator to push or pull boat in desired direction.
    - iii. Personnel operating anode pole must never use anode cable to tow/pull boat through water.
  - c. Control box
    - i. Operator of control box must maintain physical control of boat at all times.
    - ii. Operator of control box must maintain a position where the control box emergency shutdown switch may be reached quickly and easily at all times.
5. Use of Smith-Root 2.5 GPP mounted in outboard motor-powered jon boats for electrofishing non-wadeable waters
  - a. LIFE JACKETS MUST BE WORN BY ALL PERSONNEL WHEN ELECTROFISHING FROM BOATS.
  - b. Cathode cable

- i. Cathode cable should be draped over side of boat from junction box, and configured to ensure cable will not interfere with and/or become entangled with the motor's propeller.
  - ii. Ensure that only the rubber-coated insulated portion is in contact with boat, and in close physical proximity to sampling personnel.
- c. Anode pole and cable
  - i. Anode cable should be coiled neatly near bow of boat on floor away from heat producing areas of generator (e.g. engine and exhaust).
  - ii. Anode pole operator must sit near bow of boat.
  - ii. Other personnel in boat should be to the opposite side or rear of anode operator.
- d. Control box
  - i. Personnel, other than persons driving the boat or operating the anode pole should operate the control box.
  - ii. Operator of control box must maintain a position where the control box emergency shutdown switch may be reached quickly and easily at all times
- e. Motor
  - i. Operator of motor must maintain a seated position where physical control of all operating controls of motor (e.g. steering tiller, steering tiller throttle, stop switch, shifter lever, and fuel cock) can be easily and quickly reached at all times.
  - ii. Operator of motor must ensure that cathode cable remains secured in its position over side of boat. If cathode cable becomes unfixed, the operator should immediately shut down motor, until cathode cable is re-secured to side of boat.
  - iii. Motor must be shut down and inspected following propeller collision with rocks, wood, or other underwater object.

D. Operation of electrofishing equipment (Smith-Root LR-24 backpack)

The LR-24 requires two operators, a control operator and a probe operator. The control operator uses the key pad on the back side of the unit to adjust electrical parameters. The probe operator wears the unit and operates the anode pole with ring probe.

1. Assemble anode pole and ring.
2. Connect anode and cathode to LR-24 terminals, install fully charged battery, and secure in place and replace battery protective cover.
3. The control operator turns the LR-24 on and makes electrofishing parameter adjustments after electrofisher initializes. The probe operator must turn on the electrofisher probe to establish parameter settings.
4. Check on the status screen to determine the existing setting for average and peak output for power (watts), volts and amps.
5. Set waveform to standard pulse.
6. Set voltage to 250 for a fully charged battery; it may be necessary to change setting as battery output decreases with use.
7. Set frequency to 60 Hz or lower (settings of 30 - 60 Hz are generally adequate). Skin fish (catfish) may respond better to lower frequencies. If catfish are among the desired or expected target species, frequencies as low 15 Hz may be more effective.
8. Set duty cycle to 25 percent or less. Lower settings of duty cycle prolong battery use. As battery charge diminishes with use, a lowering of duty cycle may prolong the useful battery charge.

E. General field procedures

Electrofishing is conducted with a crew of 3-5 persons, including one control box operator, one probe operator, one motor operator (if electrofishing from a boat) and 1-3 staff wielding dip nets.

1. When using the LR-24 back pack or Smith-Root 2.5 GPP mounted in 10' jon

boat tote barge, electrofishing normally proceeds in an upstream direction to avoid suspending sediments ahead of the sampling crew which reduces the ability of the sampling crew to see stunned fish. Wading in an upstream direction also allows stunned fish to flow with the current toward dip net operators. Dip net operators should stand to the side, and some distance behind the probe operator depending on current velocity. The faster the stream flow velocity, the greater the distance the dip net operators should be behind the anode probe operator. Dip net operators should assist the probe operator in keeping the anode pole cable free of snags and other obstacles.

2. When using the Smith-Root 2.5 GPP electrofishing may be conducted in an upstream or downstream direction. Typically, when electrofishing large low-velocity wide non-wadeable streams and rivers, the crew will work one bank in either an upstream or downstream direction, then work the other bank in the opposite direction. In very swift water, it can be more efficient to work in a downstream direction only, because stunned fish are often carried with the current past the boat too quickly for dip net operators to successfully net the fish. Working downstream increases the amount of time dip net operators have to net stunned fish, as the fish are often floating along side the boat at roughly the same speed. Electrofishing in and among bank obstructions (e.g. low hanging tree branches, jetties, or slightly or partially submerged brush, trees, rocks or other large objects) must be avoided in very swift water situations to avoid boat entanglement, capsizing, or puncturing, and crew members possibly being pulled or falling overboard.
3. Personnel should adjust their electrofishing techniques and control parameters for maximum efficiency based on target species, water conductivity, water depth, flow velocity, and types of habitat features present. Fish may detect and avoid a steady electrical field, particularly when water conductivity is high. It is sometimes preferable to introduce electrical current intermittently, especially when approaching promising fish habitat (e.g. brush piles, holes, undercut banks). It can be very effective to apply the electrical current only when within effective range (<3 meters) of such habitat features. When working featureless stream channels (in low to medium conductivity Conditions), or when electrofishing from a boat in a downstream direction due to swift water conditions, it can be more effective to continuously apply electrical current.
4. As target species are stunned and captured, transfer specimens to nylon mesh

holding bags maintained in possession of the control box operator. Control box operator (tote barge and inflatable boat equipment) or probe operator (back pack equipment) must suspend current flow when fish are being transferred from dip nets to holding bags, until bags are secured. Bags are secured to the stern carrying handles of the 10' jon boat tote barge, side oarlock holes or carrying handles (nearest bow) on boats powered by outboard motors, or carried by the control operator of the LR-24 backpack unit. Bags should remain submerged while electrofishing is being conducted.

Bags may be lifted out of the water when using the LR-24 backpack unit or placed inside of the tote barge or motor boats when navigating through shallow water (to avoid bags dragging on stream substrates) or when navigating around obstacles such as brush piles, root wads, or submerged tree limbs (to avoid entanglement and possible damage to bags and fish). Bags should also be placed inside of motor boats when motoring at cruising speeds, in order to avoid stress and possible failure of mesh material and bag tie cords. Great care must be taken, when transporting holding bags inside of either style of boat, to ensure that the bags and/or fish specimens are not contaminated with fuel or oil. In order to avoid unnecessary stress to fish and holding bags, bags containing completed samples may be secured to shore by the use of large rocks or overhanging tree limbs. The secured bags may be retrieved when electrofishing activities are complete.

F. General electrofishing safety

In addition to the following electrofishing-specific safety procedures and precautions, field crew members need to be aware of general personal safety risks (e.g., heat exhaustion, hypothermia, poison ivy, ticks, stinging or biting insects). A cell phone must be available for emergencies at all times. A minimum crew size of three individuals must be maintained at all times. All crew members must have current American Red Cross (or equivalent) certification in cardiopulmonary resuscitation, AED, and basic first aid. The crew member assigned to operation of the control box and primary safety cutoff switch (probe junction box) must be aware of the status of all crew members at all times, particularly with respect to depth of water and chest wader freeboard, and stability of movement. The control box operator is responsible for immediately ceasing the electrofishing operation (stopping current flow) if any crew member appears at risk of immersion or is compromised from a safety perspective.

## 1. Equipment

- a. Prior to field use, all electrical equipment must be inspected to ascertain condition of insulation and functionality of safety cutoff switch and to ensure proper contact between electrical connectors.
- b. ONLY DIP NETS WITH NON-CONDUCTIVE OR INSULATED HANDLES SHALL BE USED BY MEMBERS OF THE FIELD CREW.
- c. Participants in electrofishing must wear chest waders and elbow length rubber or lined pvc gloves that are dry inside. Additional sets of waders and gloves shall be available in the event the original sets become wet.
- d. ONLY DIRECT CURRENT (DC) MAY BE USED FOR ELECTROFISHING.
- e. An AED must be present (i.e., carried in boat, jon boat or by crew members) during all electrofishing activity.
- f. When electrofishing by wading, Coast Guard approved life vests shall be available to all crew members at all times and worn if water depth or other factors (e.g., unstable, uneven, or debris-strewn substrate; turbid water; swift current) could otherwise pose a safety concern. Individual crew members may elect to wear a life jacket at all times; however, all crew members must wear a life jacket if directed to do so by the field crew leader (usually the program manager or program ESII).

## 2. Procedural Precautions

- a. When electrofishing from a boat, never enter the water while generator is running.
- b. Always turn off the electrofisher before making any connections or replacing any parts.
- c. Never reach into the water to manually retrieve fish when current is being applied to the electrodes, even if wearing protective gloves.

- d. Take a break or rotate duties when any crew member becomes fatigued to the point where they may be jeopardizing their safety or that of other crew members.
- e. Cease electrofishing activity in the event of significant wetting rain, visible lightning, audible thunder, or rapidly rising water level.
- f. Wading in flowing water of moderate velocity shall be limited to a depth of three feet or less (or the wader crotch level). Wading in water of high velocity shall be limited to locations less than two feet in depth (knee deep).
- g. Never attempt to wade under conditions of high runoff when water is flowing outside normal channel, substrate conditions are unstable, and/or current velocities are unpredictable.
- h. Avoid wading in excessively deep water where small but unexpected increases in depth could cause overtopping of waders.
- i. During transportation, the jon boat is carried on roof of sampling van and must be secured with tie down ropes. Tie down ropes must be inspected and periodically rechecked during transit.

PROCEDURES FOR FISH SAMPLE HANDLING, PRESERVATION  
AND CHAIN-OF-CUSTODY (FTCMP-003)

I. INTRODUCTION

A. Purpose

Care must be taken to avoid the inadvertent contamination of fish samples following collection. Staff must adhere to the following procedures to ensure the reported analytical results are representative of the fish tissue contaminant levels actually occurring in sampled waterbodies.

B. Equipment and Supplies

1. Heavy duty or extra heavy duty aluminum foil
2. Fiberglass reinforced strapping tape
3. 30-gallon plastic bags
4. 100-quart ice chest(s)
5. Labels, pencils, indelible markers, clipboard with sample submission forms

II. PROCEDURES

A. Sample identification

Critical to all fish collection efforts is the correct identification of the specimens that comprise the sample. Crew members are expected to have a thorough knowledge of target fish species, common game fish, other commonly consumed fish, and acceptable sampling surrogates for commonly consumed fish (e.g., Catasmidae, Percidae, Centrarchidae, Moronidae and Ictaluridae) (Cross 1967; Cross and Collins 1975, 1995; Haslouer 2004).

B. Sample size and composition, handling, and packaging

1. Sample Size and Composition.
  - a. Fillet and Whole Fish Samples

Composite fillet samples and whole fish samples should be composed

of 5 specimens of the same species and same year class (age) or size. The smallest specimen in a composite sample should be at least 75 percent of the length of the largest fish in the composite sample. Mixed species samples are acceptable if same species samples cannot be obtained with reasonable sampling effort.

b. Tissue Plug Samples – for analysis of Mercury

Because a single fillet plug is collected from an individual fish, each fish analyzed is considered an individual sample. However, 5 individual fish (e.g. samples) of the target species should be collected from a sampling site. Sample sizes of greater or less than 5 fish may be used in certain circumstances. The largest and smallest fish (length) in the samples need not be within 75 percent. Mixed species samples are acceptable if same species samples cannot be obtained with reasonable sampling effort.

2. Diligent attention must be given to the avoidance of contamination during the collection, identification and packaging of samples. Collectors must ensure their hands are clean prior to handling fish. This is particularly important after handling gasoline containers or gasoline-powered equipment.
3. Prior to identification and packaging, collected fish should be kept immersed in water, (e.g. in a holding well, in a net bag, or on a stringer). Collected fish should be rinsed with water from the stream or lake of origin prior to packaging if there is reason to believe that they may have contacted any surface which may be contaminated with insecticides, herbicides, heavy metals, oil, greases, or other such substances.
4. Surfaces on which collected fish are placed for identification and packaging must be kept clean and covered with new aluminum foil (shiny side down).
5. In situations where a sample consists of different species of fish, each individual specimen should be labeled to indicate the sample number and common name of the specimen (STORET fish species codes, Form App. C-1). When the sample consists of specimens that are all the same species, the sample (group of specimens) may be labeled collectively.
6. Using extra-heavy duty or double layered heavy duty aluminum foil, wrap each specimen individually, unless the sample consists of numerous small specimens (e.g., 20 minnows each 2-3 inches in length). In such a case specimens may be wrapped as a group. Individually wrapped specimens

comprising a sample should be bundled together with fiberglass reinforced tape, and the identity of the bundle should be clearly printed on the label with indelible ink. Attach the sample tag to the outside of the aluminum foil, not to the fish. Place the labeled bundle in a clean, unused plastic bag with an additional sample tag on the outside.

7. Fish species having large sharp pectoral, dorsal, or anal fin spines (e.g. channel catfish and common carp) may puncture aluminum foil wrapping. To avoid this, clip fin spines with wire cutters, taking care to not clip the skin of the fin free of the body. Spines should remain attached to the fish
8. Field fish sample tag.
  - a. Field fish tags should be at least 3' x 5'. Index cards or cut pieces of thin uncorrugated cardboard, cut out from cardboard packaging such as cereal boxes, may be used as tags. If using recycled cardboard from packaging, the unprinted side must be used for labeling.
  - b. Date, sampling time (e.g. start and stop time of electrofishing, angling, netting, trapping, etc.), waterbody, sample site number (if established), sampling crew members present, program name (e.g. Trend, ADVFOL, Probability, Class B, Class A, etc.), field preservation method (e.g. wet ice or dry ice), species name, and number of fish in bundle must clearly printed on label with and indelible ink pen or permanent marker (e.g. Sharpie).
  - d. The time at which samples are placed in either an ice chest with dry ice, or placed in a freezer (when using wet ice) must be noted on the field sample tag.
  - e. Sample tag must be securely taped to the sample bundle with fiber glass reinforced tape.

C. Field sample preservation and preservation of samples prior to laboratory preparation

Once the samples have been wrapped and labeled, they should be placed in an ice chest (cooler) containing ice or dry ice immediately. Sample bundles must be placed in clean, unused, heavy-weight plastic bags to keep samples dry. Samples must be immediately placed in a freezer for storage upon return to either the BOW laboratory at the Curtis State Office Building, or a temporary holding facility (e.g. KDWPT, county, federal offices).

1. Wet ice may be used to preserve samples collected and returned to a facility for storage in a freezer during the course of a single day.
2. Wet ice may be used for transporting solidly frozen samples from a temporary holding facility to the BOW laboratory.
3. Dry ice must be used to preserve samples collected on overnight, or multiple night sampling trips. Dry ice should be placed underneath and on top of sample bundles to ensure complete freezing.
4. Stored samples must be kept solidly frozen (20° C) until they can be processed by the receiving laboratory.

D. Chain-of-Custody

Chain-of-custody procedures apply to all samples and all EPA Region 7 field collection and laboratory submission forms (see Form APP. C-2 and App. C-3). Following sample collection by KDHE personnel and transfer to the BOW laboratory, all samples are considered to be in the possession of the program manager or field coordinator. Samples collected by outside agencies (e.g. KDWPT and EPA) are not considered in possession of the program manager or field coordinator, until picked up by either employee from a temporary holding facility or delivery to the BOW laboratory by outside agency personnel. Samples collected by EPA personnel and transported by EPA personnel to the EPA Region 7 laboratory are considered to be in possession of EPA laboratory personnel.

For each sub-program a separate chain-of-custody form is completed. The program manager's name and telephone number is indicated at the top of the form. Sample numbers are listed on the chain-of-custody form followed by notation of whether the sub-program submission is complete or in part for that year.

For each sample relinquished to the laboratory, either the program manager or field coordinator must date and sign the chain-of-custody form in the "relinquished by" blank on chain-of-custody form APP.C-3. Photocopies of all laboratory submission forms (Form APP. C-2) are retained by the program manager, before delivery to EPA laboratory personnel. Carbon copies of chain-of-custody forms, signed by laboratory sample receiving personnel, are retained by the program manager.

PROCEDURES FOR PREPARATION OF FISH FILLET  
(EDIBLE PORTION) SAMPLES (FTCMP-004)

I. INTRODUCTION

A. Purpose

Care must be taken to avoid the inadvertent contamination of fish samples during fillet preparation. Staff must adhere to the following procedures to ensure the reported analytical results are representative of the fish tissue contaminant levels actually occurring in sampled waterbodies.

B. Equipment and Supplies

1. Fillet knives (2 sizes)
2. Truer
3. Sharpening stone
4. Heavy duty or extra-heavy duty aluminum foil
5. Large pan, single beam, balance (15.5 kg capacity)
6. Fish measuring board
7. Chest type freezer
8. Preprinted EPA laboratory labels
9. Indelible markers
10. Polyethylene carboy containing glass-distilled water
11. Nitrile disposable gloves
12. Paper towels
13. EPA Field Sheet and Sample Submission Form APP. C-2
14. EPA Laboratory Sample Chain-of-Custody Form APP. C-3

## II. PROCEDURES

Samples to be filleted are processed, packaged, and returned to the laboratory freezer. Filleting of samples takes place in the BOW laboratory under clean working conditions (essentially contaminant free).

- A. Prior to filleting, all work surfaces and processing equipment are washed with a mild detergent solution and rinsed with glass distilled water. Work surfaces are covered with clean aluminum foil (shiny side down) and processing personnel put on clean nitrile disposable gloves before handling fish.
- B. Fish samples to be filleted are removed from the freezer and allowed to thaw partially (1-4 hours). When fish have thawed at the surface adequately to be unwrapped, each fish is weighed to the nearest 10 grams on a large pan, beam-type balance and measured for total length (tip of snout to tip of tail) to the millimeter on a fish measuring board. The measurements are recorded for each specimen. The average weight (grams) and average length (millimeters) are recorded on the EPA field sheet and sample submission form (Form APP. C-2).
- C. Once fish have thawed sufficiently so that the deepest portions of the muscle tissue still contain frost but are no longer fully frozen, they are ready to be filleted.
- D. Fillet techniques may vary among individual employees; however, regardless of the filleting technique care must be taken to avoid puncturing the abdominal or gut lining when working around the rib cage and anal area. Only the skin of the fillet should come into contact with the aluminum foil sheet covering the laboratory stainless steel table. Mucus, scales, dirt, and/or feces often accumulate on the foil sheet as a sample is being processed, therefore extra care must be exercised when using the knife to remove skin from fillets.
- E. Package (tightly wrap) the fillets in new clean (shiny side out) foil and apply appropriate pre-printed sample label as provided by the EPA laboratory. Cover label with clear packing tape so that tape wraps completely around package to avoid label slipping off.
- F. Between samples, rinse the fillet knife with glass distilled water (scrub off any stuck pieces of tissue, scales, or hardened mucus) and place a new aluminum foil sheet on filleting table (shiny side down).

PROCEDURES FOR THE PREPARATION OF FILLET TISSUE PLUG (EDIBLE PORTION)  
SAMPLES FOR MERCURY ANALYSIS (FTCMP-005)

I. INTRODUCTION

A. Purpose

Care must be taken to avoid the inadvertent contamination of fish samples during fillet plug preparation. Staff must adhere to the following procedures to ensure the reported analytical results are representative of the fish tissue contaminant levels actually occurring in sampled waterbodies.

B. Equipment and Supplies

1. Sterile disposable stainless steel 5 mm biopsy punch tool
2. Sterile disposable stainless steel scalpel
3. 20 mm glass scintillation vials
4. Pipette bulb
5. Fish measuring board
6. Large pan, single beam, balance (15.5 kg capacity)
7. Electronic scale and plastic tub
8. Chest type freezer
9. Heavy duty or extra-heavy duty aluminum foil
10. Preprinted EPA laboratory labels
11. Indelible markers
12. Polyethylene carboy containing deionized water
13. Nitrile disposable gloves
14. Bi-fold paper towels in steel wall-mounted dispenser

15. Water resistant paper
16. Aluminum storage clipboard
17. EPA Field Sheet and Sample Submission Forms (Form APP. C-2)

## II. PROCEDURES

Samples to be tissue plugged are processed, packaged, and returned to the laboratory freezer. Tissue plugging normally takes place in the BOW laboratory under clean working conditions (essentially contaminant free). Under certain circumstances tissue plugs may be obtained and processed under field conditions.

### A. Field (No-Kill) tissue plugging procedure

Field tissue plugging procedures are essentially the same as the laboratory procedures. When fillet plugs are to be prepared in the field every effort is made to avoid contamination of equipment, supplies, and samples. All equipment and supplies will be transported to the field in a clean decontaminated cooler. All completed samples will be transported back to the BOW laboratory in a decontaminated cooler on wet ice or dry ice (FTCMP-003).

1. Prior to packing equipment and supplies for transport to the field, all work surfaces and processing equipment are washed with a mild detergent solution and rinsed with glass distilled water. Preprinted EPA laboratory sample labels are applied to scintillation vials. Labels are sealed with clear tape. Vial labels are checked to ensure the ASR numbers and sample numbers match the samples to be processed. Vials are returned to original shipping box for protection during transport.
2. Live fish should be either plugged immediately after capture or stored in a live-well with circulating ambient water or an aerated holding tank replenished with fresh water at regular intervals until ready for processing.
3. Prior to taking tissue plugs, work surfaces are covered with clean aluminum foil (shiny side down) and processing personnel put on nitrile disposable gloves.
4. Each fish is weighed to the nearest 10 grams and measured for total length (tip of snout to tip of tail) to the nearest 0.5 cm on a fish measuring board. The measurements are recorded for each specimen. The sample number

associated with each fish, weight (grams), and length (millimeters) are recorded on water resistant paper and stored in aluminum storage clipboard.

5. A disposable scalpel is used to gently scrape scales from small area below dorsal fin. If the processing personnel prefer and have sufficient experience to do so without causing unnecessary tissue damage and stress to the fish they may at this time remove the skin from the scaled area with the scalpel.
6. Using light pressure press the biopsy punch into the fillet tissue just below the dorsal fin. Use a turning motion to loosen the tissue until the plug can be removed.
7. Secure pipette bulb to the top of biopsy punch. Squeeze pipette bulb to deposit the tissue plug onto a clean piece of aluminum foil if skin is still attached. Use the scalpel to slice skin away from the muscle tissue and use the scalpel or clean stainless steel forceps to deposit the tissue plug into a scintillation vial. If no skin is attached to the tissue plug deposit the tissue plug directly into the scintillation vial using the pipette bulb.
8. Seal the tissue plug in a scintillation vial and return vial to original shipping box.
9. Scalpel, biopsy punch tool, and forceps may be reused for all fish from the same sampling site, however they must be rinsed with glass distilled water after each fish is plugged. Care must be taken to scrub off any stuck pieces of tissue or thick mucus. If depositing tissue plugs on aluminum foil to remove skin, take care to utilize an unused portion of the foil surface for each tissue plug. Replace foil with new as needed. Before discarding used scalpels and biopsy punch tools, replace cutting edge guards.
10. When the samples for a site have been processed (or between fish if plugging is conducted as fish are captured) return original shipping box to cooler containing wet ice or dry ice. If using wet ice ensure that shipping box does not become wet by sealing box in a clean unused plastic trash bag.
11. Upon completing field work and returning to the laboratory, ensure the length and weight data recorded in the notebook are transferred to EPA field sheets and sample submission forms (Form APP. C-2).

B. Laboratory tissue plugging procedure

1. Prior to plugging, all work surfaces and processing equipment are washed with a mild detergent solution and rinsed with glass distilled water. Work surfaces are covered with clean aluminum foil (shiny side down). Preprinted EPA laboratory sample labels are applied to scintillation vials. Vial labels are checked to ensure the ASR numbers and sample numbers match the samples to be processed.
2. Fish samples to be plugged are removed from the freezer and allowed to thaw partially (1-4 hours). When fish have thawed at the surface adequately to be unwrapped, each fish is weighed to the nearest 10 grams on a large pan, beam-type balance and measured for total length (tip of snout to tip of tail) to the nearest 0.5 cm on a fish measuring board. The measurements are recorded for each specimen on the EPA field sheet and sample submission form (Form APP. C-2).
3. Once fish have thawed sufficiently so that the depth of the muscle tissue penetrated by the biopsy punch tool still contains frost but is no longer fully frozen, they are ready.
4. A disposable scalpel is used to gently scrape scales from small area below dorsal fin. If the processing personnel prefer, they may also remove the skin from the scaled area with the scalpel.
5. Using light pressure press the biopsy punch into the fillet tissue just below the dorsal fin. Use a turning motion to loosen the tissue until the plug can be removed. The plug will remain in the biopsy punch.
6. Secure pipette bulb to the top of biopsy punch. Squeeze pipette bulb to deposit the tissue plug onto a clean piece of aluminum foil if skin is still attached. Use scalpel to slice skin away from the muscle tissue and use the scalpel or clean stainless steel forceps to deposit the tissue plug into a scintillation vial. If no skin is attached to the tissue plug deposit the tissue plug directly into the scintillation vial using the pipette bulb.
7. Seal the tissue plug in a pre-labeled scintillation vial and place vial in original shipping box.
8. Scalpel, biopsy punch tool, and forceps may be reused for all fish from the same sampling site, however they must be rinsed with glass distilled water after each fish is plugged. Care must be taken care to scrub off any stuck

pieces of tissue or thick mucus. If depositing tissue plugs on aluminum foil to remove skin take care to utilize an unused portion of the foil surface for each tissue plug. When all fish from a single sample site have been processed, discard foil, scalpel, and biopsy punch tool. Before discarding used scalpels and biopsy punch tools, replace cutting edge guards. New foil, scalpel, and biopsy punch tool must be used when fish from a new sample site are processed.

9. When the samples been processed return original shipping box to freezer.

PROCEDURES FOR THE ISSUANCE OF FISH CONSUMPTION  
ADVISORIES AND WARNINGS (FTCMP-006)

I. PURPOSE

The following paragraphs describe the procedures for the issuance of fish consumption advisories and warnings (FTMP-006). Fish consumption advisories and warnings consist of a joint KDHE/KDWPT press release describing the affected area, species included, and type of advisory or warning recommendation. A background information packet characterizing the risk assessment process and methods for reducing risk, is made available to the press and, upon request, to the general public. Advisories and warnings are formulated annually no later than December 1<sup>st</sup> so that they may be published in KDWPT's brochure, *Kansas Fishing Regulations*, the following calendar year. The official press release normally is issued by KDHE/KDWPT during the first full week of the January.

II. PROCEDURES

A. Risk Assessment

Standard risk assessment techniques are applied and potential cancer causing and non-cancer causing endpoints of toxicity are considered in the issuance of fish consumption advisories and warnings (EPA 1989, 1995a, EPA 1995b, 1999, 2000). The following assumptions and minimum data requirements apply:

1. Risk assessment assumptions
  - a. Consumer body weight: adult = 70 kg (154.3 pounds); children = 36 kg (79.4 pounds).
  - b. Lifetime exposure period = 72 years.
  - c. Meal size 8 ounces (226.8 grams), or approximately 6 ounces (170.1 grams) after cooking for adults and 4 ounces (113.4 grams) for children.
  - d. Fish consumption is the only route of exposure.
  - e. All of the contaminant consumed is retained by consumer.

- f. Lipophilic contaminants (organochlorine compounds): 100 percent of the contaminant measured in raw fillet sample is retained through the cooking process.
  - g. Non-lipophilic contaminants (e.g., mercury): all of the contaminant measured in raw fillet sample is retained through the cooking process.
  - h. EPA carcinogenic potency factor for carcinogenic end points, or EPA RfD (risk reference dose) for noncarcinogenic end points of toxicity are accurate.
  - i. For carcinogens, a 1:100,000 upper-bound estimated excess cancer risk applies; for noncarcinogens, a hazard index of less than 1.0 is deemed an acceptable risk.
2. Minimum data requirements for advisory/warning issuance
- a. At least three duplicate composite fillet samples (3-6 fish each) shall be used for computation of the risk assessment measure of contaminant central tendency (median for carcinogens and mean for noncarcinogens).
  - b. Calculation of contaminant concentration central tendency shall account for non-detects using Robust Regression on Ordered Statistics (ROS) for medians and adjusted lognormal Maximum Likelihood Estimation (MLE) for means (Helsel and Hirsh 2002; Helsel 2005).
  - c. In the case of contaminants where the primary route of accumulation in fish may be direct contact with or ingestion of sediments (e.g., chlordane), samples shall be composed of a representative species of bottom-feeding fish. In the case of contaminants where food chain accumulation is the primary route of exposure (e.g., mercury), samples shall be, when ever possible, comprised of a representative species of predatory fish.
  - d. Fish samples shall be collected from candidate advisory waterbodies over a minimum period of 3 consecutive years.
  - e. Most advisories will be based on more than minimal data requirements. For example most will involve large numbers of duplicate or replicate samples, multiple species of fish, and more than 3 years of sample collection data.

VEHICLE SAFETY AND MAINTENANCE PROCEDURES  
(SCMP-002)

I. INTRODUCTION

A. Purpose

The following paragraphs describe the standard vehicle safety and maintenance procedures used during collection and transportation of fish tissue samples. Safety procedures are established to prevent or minimize property damage, personal injuries, and/or loss of life. Maintenance procedures are established to prevent or minimize vehicle breakdowns and to extend the useful life of the vehicle.

B. Equipment and Supplies

Late model full size van or other suitable vehicles, as available.

II. PROCEDURES

- A. Procedures described in SOP No. SCMP-002 are adopted by reference.

PROCEDURES FOR OBTAINING SAMPLING SITE COORDINATES WITH  
GARMIN GPSIII+ (SBMP-007)

I. INTRODUCTION

A. Purpose

This SOP describes the procedures used for documenting the geographical position (latitude and longitude) of fish sample collection locations (waterbody entry points). Accurate use of the global positioning system (GPS) facilitates the analysis of monitoring data through geographical information system (GIS) techniques.

B. Equipment

1. Garmin GPSIII+ or V hand held GPS unit.
2. Garmin MapQuest software.

II. PROCEDURES

- A. Procedures described in SOP No. SBMP-006 are adopted by reference.

**APPENDIX C**

**STANDARDIZED FIELD AND LABORATORY FORMS**

**FISH TISSUE CONTAMINANT MONITORING PROGRAM**

**STORET Fish Species Codes**  
**Form APP. C-1**

<u>Common name</u>	<u>Scientific name</u>	<u>STORET code</u>
Bigmouth Buffalo	<i>Ictiobus cyprinellus</i>	3
Black Buffalo	<i>Ictiobus niger</i>	105
Black Bullhead	<i>Ameiurus melas</i>	4
Black Crappie	<i>Pomoxis nigromaculatus</i>	5
Black Redhorse	<i>Moxostoma duguesnei</i>	389
Blue Catfish	<i>Ictalurus furcatus</i>	67
Blue Sucker	<i>Cycleptus elongatus</i>	386
Bluegill	<i>Lepomis macrochirus</i>	8
Common Carp	<i>Cyprinus carpio</i>	12
Channel Catfish	<i>Ictalurus punctatus</i>	16
Flathead Catfish	<i>Pylodictis olivaris</i>	19
Freshwater Drum	<i>Aplodinotus grunniens</i>	20
Goldfish	<i>Carassius auratus</i>	24
Golden Redhorse	<i>Moxostoma erythrurum</i>	390
Green Sunfish	<i>Lepomis cyanellus</i>	25
Highfin Carpsucker	<i>Carpionodes velifer</i>	385
Largemouth Bass	<i>Micropterus salmoides</i>	31
Longear Sunfish	<i>Lepomis megalotis</i>	72
Mixed species		64
Northern Hog Sucker	<i>Hypentelium nigricans</i>	94
Northern Pike	<i>Esox lucius</i>	36
Paddlefish	<i>Polyodon spathula</i>	106
Pumpkinseed	<i>Lepomis gibbosus</i>	38
Quillback	<i>Carpionodes cyprinus</i>	74
Rainbow Trout	<i>Oncorhynchus mykiss</i>	39
Redear Sunfish	<i>Lepomis microlophus</i>	40
River Carpsucker	<i>Carpionodes carpio</i>	42
River Redhorse	<i>Moxostoma carinatum</i>	388
Sauger	<i>Sander canadensis</i>	46
Shorthead Redhorse	<i>Moxostoma macrolepidotum</i>	101
Silver Redhorse	<i>Moxostoma anisurum</i>	170
Smallmouth Bass	<i>Micropterus dolomieu</i>	47
Smallmouth Buffalo	<i>Ictiobus bubalus</i>	48
Spotted Bass	<i>Micropterus punctulatus</i>	49
Spotted Sucker	<i>Minytrema melanops</i>	51
Striped Bass	<i>Morone saxatilis</i>	52
Walleye	<i>Sander vitreus</i>	55
Warmouth	<i>Lepomis gulosus</i>	56
White Bass	<i>Morone chrysops</i>	57
White Crappie	<i>Pomoxis annularis</i>	59
White Sucker	<i>Catastomus commersonii</i>	61
Wiper	<i>Morone saxatilis / chrysops</i>	198
Yellow Bullhead	<i>Ameiurus natalis</i>	62
Yellow Perch	<i>Perca flavescens</i>	63

## Form APP. C-2

**Kansas City, KS**

**ASR Number:** 3201    **Sample Number:** 101    **QC Code:**    **Matrix:** Tissue    **Tag ID:** 3201-101-

**Project Manager:** Lorenzo Sena

**Project Desc:** RAFT - Kansas Status Samples 2006

State: Kansas

**Program:** Ambient Water Quality

**Location Desc:** Milford Lake

**External Sample Number:** \_\_\_\_\_

**Expected Conc:** (or Circle One: ☐ Low ☐ Medium ☐ High)

Time(24 hr)

**Sample Collection: Start:**

**End:**                      

### Field Measurement

### Units

Average Length : \_\_\_\_\_ mm

Average Weight : \_\_\_\_\_ Grams

County : \_\_\_\_\_ N/A

Fish Species STORET ID# : \_\_\_\_\_ I.D. \_\_\_\_\_

Fish Species Common Name : \_\_\_\_\_ N/A

Type ( Btm Feeder Predator ) : \_\_\_\_\_ N/A

Latitude : \_\_\_\_\_ Dec. Deg. \_\_\_\_\_

Longitude : \_\_\_\_\_ Dec. Deg. \_\_\_\_\_

Number of Specimens : \_\_\_\_\_ #

Sample Type ( Trend Status Follow-up ) : \_\_\_\_\_ N/A

State ( IA KS MO NE ) : \_\_\_\_\_ N/A

**Rationale ( Probab Random Targeted Census ) :** \_\_\_\_\_ **N/A**

Tissue Analyzed ( Fillet Whole ) : N/A

Waterbody Name : \_\_\_\_\_ N/A

Type (Lake - A B C Big River Non-Wade Wade) : N/A

Year ( 2006 2007 2008 ) : \_\_\_\_\_ N/A

**Laboratory Analyses:**

Container	Preservative	Holding Time	Analysis
1 - foil wrapped	Freeze	180 Days	1 Mercury in Tissue
1 - foil wrapped	Freeze	180 Days	1 Metals in Fish by ICP
0 - foil wrapped	Freeze	0 Days	1 Percent Lipid in Tissue
1 - foil wrapped	Freeze	0 Days	1 Followup Fish Pesticides, Fillet, by GC/EC

**Sample Comments:**

### Bottom Feeder

**Sample Collected By:** \_\_\_\_\_

**Form APP. C-3**7-EPA-9262(Revised 5/85)

## APPENDIX D

### PRIMARY PARAMETERS OF INTEREST AND CORRESPONDING MINIMUM REPORTING LIMITS

#### Routine Inorganic Parameters MRL (mg/kg, wet weight)

Cadmium	0.06
Lead	0.35
Mercury	0.0056
Selenium	1.13

#### Routine Organic Parameters

Technical Chlordane	0.03
cis-Chlordane	0.002
trans-Chlordane	0.002
cis-Nonachlor	0.002
trans-Nonachlor	0.002
Oxychlordane	0.002
Heptachlor	0.003
Heptachlor epoxide	0.003
gamma-Hexachlorocyclohexane (G-BHC)	0.002
Dieldrin	0.003
p,p'-DDT	0.005
p,p'-DDE	0.005
p,p'-DDD	0.004
Trifluralin (Treflan)	0.003
PCB (Aroclor)-1248	0.04
PCB-(Aroclor)1254	0.03
PCB-(Aroclor)1260	0.02
Hexachlorobenzene	0.001
Pentachloroanisole	0.001

## APPENDIX E

### REFERENCES

- Anderson, D.W. and J.J. Hickey. 1970. Oological data on egg and breeding characteristics of brown pelicans. *Wilson Bulletin* 82(1):14-28.
- Arruda, J.A., M.S. Cringan, D. Gilliland, S.G. Haslouer, J.E. Fry, R. Broxterman and D.L. Brunson. 1987. Correspondence between urban areas and the concentrations of chlordane in fish from the Kansas River. *Bulletin of Environmental Contamination and Toxicology* 39:563-570.
- Bowerman, W.W., J.P. Giesy, D.A. Best and V.J. Kramer. 1995. A review of factors affecting productivity of bald eagles in the Great Lakes region: Implications for recovery. *Environmental Health Perspectives* 103(4):51-59.
- Capel, S. 1972. Pesticide residues in Kansas streams. Kansas Forestry Fish and Game Commission. Job No. K-1-1.
- Colborn, T. 1991. Epidemiology of Great Lakes bald eagles. *Journal of Toxicology and Environmental Health* 33:395-453.
- Cross, F.B. 1967. Handbook of Fishes of Kansas. University of Kansas, Museum of Natural History Miscellaneous Publications; No. 45.
- Cross, F.B. and J.T. Collins. 1975. Fishes in Kansas. University of Kansas, Museum of Natural History Public Education Series; No. 3.
- Cross, F.B. and J.T. Collins. 1995. Fishes in Kansas. University of Kansas, Museum of Natural History Public Education Series; No. 14.
- Environmental Protection Agency. 1973. Water quality criteria 1972. EPA-R3-73-033.
- Environmental Protection Agency. 1980. Manual of analytical methods for the analysis of pesticides in human and environmental samples. EPA-600/8-80-038.
- Environmental Protection Agency, Region 7. 1987. Standard operating procedure for fish collection No. FW019C.
- Environmental Protection Agency. 1989. Assessing human health risks from chemically contaminated fish and shellfish: A guidance manual. EPA-503/8-89-002.

- Environmental Protection Agency. 1992. National study of chemical residues in fish. Vol. 1. EPA 823-R-92-008a.
- Environmental Protection Agency. 1992. National study of chemical residues in fish. Vol. 2. EPA 823-R-9-009.
- Environmental Protection Agency. 1995b. Guidance for assessing chemical contaminant data for use in fish advisories. Vol.4. Risk Communication.
- Environmental Protection Agency. 2000. Guidance for assessing chemical contaminant data for use in fish advisories. EPA 823-B-00-007. Vol. 1. Fish Sampling and Analysis (3<sup>rd</sup> Edition).
- Environmental Protection Agency. 2000. Guidance for assessing chemical contaminant data for use in fish advisories. EPA 823-B-00-008. Vol. 2. Risk Assessment and Fish Consumption Limits (3<sup>rd</sup> Edition).
- Environmental Protection Agency. 2000. Guidance for assessing chemical contaminant data for use in fish advisories (2<sup>nd</sup> Edition). EPA 823-B-00-009. Vol. 3. Risk Management Draft.
- Haslouer, S.G. 2004. Taxonomic synonymy of Kansas fish collections 1855-1995. Kansas Biological Survey Technical Report 115.
- Helsel, D.R. 2005. Nondetects and data analysis: statistics for censored environmental data. John Wiley and Sons, Inc., Hoboken, New Jersey.
- Helsel, D.R. and P.R.M. Hirsch. 2002. Statistical methods in water resources; USGS Techniques of Water-Resource Investigations, Book 3, Chapter A3.
- Henny, C.J., R.A. Grove, J.L. Kaiser and V.R. Bently. 2004. An evaluation of osprey eggs to determine spatial residue patterns and effects of contaminants along the lower Columbia River, USA. Raptors Worldwide: Budapest, Hungary, WWGBH/MME, p. 369-388.
- Hickey, J.J. and D.W. Anderson. 1968. Chlorinated hydrocarbons and eggshell changes in raptorial and fish eating birds. Science 162:(850):271-273.
- Kansas Department of Health and Environment. 2009. Kansas surface water register. Bureau of Environmental Field Services, Kansas Department of Health and Environment, Topeka, Kansas. 70pp.
- Kansas Department of Health and Environment. 2010. Press release on fish consumption advisories and warnings. [http://www.kdheks.gov/BOW/download/Kansas\\_Issues\\_Revised\\_Fish\\_Consumption\\_Advisories\\_2010.pdf](http://www.kdheks.gov/BOW/download/Kansas_Issues_Revised_Fish_Consumption_Advisories_2010.pdf)

- Lichter, J., H. Caron, T.S. Pasakarnis, S.K. Rodgers, T.S. Squiers and C.S. Todd. 2006. The ecological collapse and partial recovery of a freshwater tidal ecosystem. *Northeastern Naturalist*. 13(2):153-178.
- Lillie, J. 1973. Pesticide residues in Kansas streams. Kansas Forestry Fish and Game Commission. Job No. K-1-2.
- Lillie, J. 1974. Pesticide Residues in Kansas Streams. Kansas Forestry Fish and Game Commission. Job No. K-1-3.
- Schmidt, C.J. (ed.) 2002. Biomonitoring of environmental status and trends (BEST) program: Environmental contaminants and their effects on fish in the Mississippi River Basin. Biological Science Report. USGS/BRD/BSR 2002-0004.
- Schmidt, C.J. and W.G. Brumbaugh. 1990. National contaminant biomonitoring program: Concentrations of arsenic, cadmium, copper, lead, mercury, selenium and zinc in freshwater fishes of the United States, 1976-1984. *Archives of Environmental Contamination and Toxicology* 19(5):731-747.
- Schmidt, C.J., J.L. Ludke and D.F. Walsh. 1981. Organochlorine residues in fish: National pesticide monitoring program, 1970-74. *Pesticide Monitoring Journal* 14(4):136-206.
- Schmidt, C.J., M.A. Ribick, J.L. Ludke and T.W. May. 1983. National pesticide monitoring program: Organochlorine residues in freshwater fish, 1976-79. United States Department of Interior, United States Fish and Wildlife Service, Research Publication 152.
- Schmidt, C.J., J.L. Zajicek and P.H. Peterman. 1990. National contaminant biomonitoring program: residues of organochlorine chemicals in U.S. freshwater fish, 1976-1984. *Archives Environmental Contamination and Toxicology* 19(5):748-781.
- Topic Popovic, N. and I. Strunjak-Perovic. 1999. Bioaccumulation of lipid-soluble pollutants in aquatic systems. *Ribarstvo* 57(1):3-11.

## APPENDIX F

### GLOSSARY OF TERMS

**accuracy** -- the extent to which a measured value actually represents the condition being measured. Accuracy is influenced by the degree of random error (precision) and systematic error (bias) inherent in the measurement operation (e.g., environmental sampling and analytical operations).

**activity** -- an all inclusive term describing a specific set of operations or related tasks to be performed, either serially or in parallel (e.g., research and development, field sampling, analytical operations) that in total result in a product or service.

**assessment** -- the evaluation process used to measure the performance or effectiveness of a system and its elements. As used in this QMP, "assessment" is an all-inclusive term used to denote audits, performance evaluations, management system reviews, internal reviews and related actions.

**audit** -- a systematic and independent examination to determine whether quality activities and related results comply with planned arrangements and whether these arrangements are implemented effectively and are suitable to achieve objectives.

**bias** -- the systematic or persistent distortion of a measurement process which causes errors in one direction (i.e., the degree to which the expected sample measurement is different from the true sample value).

**bioaccumulate** -- the increase in the concentration of a substance, especially a contaminant, in an organism or in the food chain over time.

**calibration** -- comparison of a measurement standard, instrument, or item with a standard, instrument or item of higher accuracy to detect, quantify and report inaccuracies and to eliminate these inaccuracies through adjustments.

**chain of custody** -- an unbroken trail of accountability that ensures the physical security of samples, data and records.

**comparability** -- a measure of the confidence with which one item (e.g., data set) can be compared to another.

**completeness** -- a measure of the amount of valid data obtained from a measurement system compared to the amount that was expected to be obtained under normal conditions.

**computer program** -- a sequence of instructions suitable for processing by a computer. Processing may include the use of an assembler, compiler, interpreter, or translator to prepare the program for execution. A computer program may be stored on electrical, magnetic or optical media.

**corrective action** -- any measure taken to rectify a condition adverse to quality and, where possible, to preclude its recurrence.

**data performance criteria** -- qualitative and quantitative statements that define the appropriate type of data and/or specify tolerable levels of potential decision errors used as the basis for establishing the quality and quantity of data needed to support decisions.

**data quality assessment** -- a scientific and statistical evaluation of a set of environmental data to determine the adequacy of the data for its intended use.

**deficiency** -- an unauthorized deviation from acceptable procedures or practices.

**design** -- specifications, drawings, criteria, and performance requirements resulting from deliberate planning, analysis, mathematical computation, and/or other processes.

**design change** -- any proposed or implemented revision or alteration of the technical requirements stipulated in an approved design output document.

**design review** -- an evaluation of a proposed design to determine if it will meet established design and performance criteria.

**document** -- any written or pictorial information describing, defining, specifying, reporting, or certifying activities, requirements, procedures or results.

**duplicate samples** -- paired samples collected at essentially the same time from the same site and carried through all assessment and analytical procedures in an identical manner. Duplicate samples are used to measure natural variability as well as the precision of a method, monitoring instrument, and/or analyst. More than two such samples are referred to as replicate samples.

**environmental data** -- the description of a physical medium (e.g., air, water, soil, sediment) or biological system expressed in terms of some measurable physical, chemical, radiological, or biological characteristic or set of characteristics.

**environmental monitoring program** -- a planned and systematic operation for characterizing an environmental process or condition. For the purposes of this QMP, the term "program" refers to a major, ongoing or longer term environmental monitoring operation.

**fillet** -- the portion of a fish most commonly consumed by humans and composed primarily of muscle tissue without the skin or scales, fins, skeletal structures, head, or internal organs.

**independent assessment** -- a quality assessment of an environmental monitoring program, project or system performed by a qualified individual, group, or organization that is not part of the program, project or system.

**inspection** -- examination or measurement of an activity to verify conformance with specific requirements.

**internal assessment** -- any quality assessment of the work performed by an individual, group, or organization, conducted by those overseeing and/or performing the work.

**method** -- a body of procedures for performing an activity in a systematic and repeatable manner.

**organization** -- a company, corporation, firm, enterprise, or institution, or part thereof, whether incorporated or not, public or private, that has its own functions and administration.

**peer review** -- a critical review of a finding or document conducted by qualified individuals other than those who produced the finding or document but collectively equivalent in technical expertise.

**performance evaluation** -- a type of audit in which the quantitative data generated in a measurement system are obtained independently and compared with routinely obtained data to evaluate the proficiency of a technician, analyst or laboratory.

**precision** -- the level of agreement among individual measurements of the same property, conducted under identical or similar conditions.

**qualified data** -- data that have been modified, adjusted or flagged in a data base following data validation and verification procedures.

**quality** -- those features of a product or service that bear on its ability to meet the stated or implied needs and expectations of the user.

**quality assurance (QA)** -- an integrated system of management activities involving planning, implementation, assessment, reporting, and quality improvement to ensure that a process, item, or service is of the type and quality needed and expected by the user.

**quality assurance project (program) plan (QAPP)** -- a formal document that describes in detail the necessary QA, QC, and other technical activities that must be implemented to ensure that the results of the work performed for the program or project satisfy the stated performance criteria.

**quality control (QC)** -- the overall system of technical activities that measures the attributes and performance of a process, item, or service against defined standards to verify that they meet the stated requirements of the user.

**quality management plan (QMP)** -- a formal document that describes a quality management system in terms of the organizational structure, functional responsibilities, and planning, implementation and assessment of work.

**record** -- a document or portion thereof furnishing evidence of the quality of an item or activity, verified and authenticated as technically complete and correct. Records may include reports, photographs, drawings, and data stored on electronic, magnetic, optical or other recording media.

**relative percent difference (RPD)** -- value calculated by subtracting the lower of two duplicate analyses from the higher, then dividing this difference by the average of the two analyses and multiplying the result by 100 to convert to percent difference.

**replicate sample** -- see duplicate sample.

**reporting limit** -- the lowest concentration of a target analyte that a given method or instrument can reliably ascertain and report as greater than zero.

**representativeness** -- a measure of the degree to which data accurately and precisely represent a selected characteristic of a monitored system.

**reproducibility** -- a measure of the degree to which sequential or repeated measurements of the same system vary from one another, independently of any actual change in the system.

**sensitivity** -- a measure of the capacity of an analytical method or instrument to discriminate between different levels of a variable of interest.

**split sample** -- a sample that has been equally divided into two or more subsamples. Split samples generally are submitted to different analysts or laboratories and used to measure the precision of the applied analytical method and/or to detect possible problems in the performance of the participating analysts or laboratories.

**standard operating procedure (SOP)** -- a written, formally approved document that comprehensively and sequentially describes the methods employed in a routine operation, analysis or action.

**technical review** -- a critical review of an operation by independent reviewers collectively equivalent in technical expertise to those performing the operation.

**validation** -- the establishment of a conclusion based on detailed evidence or by demonstration. This term is often used in conjunction with formal legal or official actions.

**verification** -- the establishment of a conclusion based on detailed evidence or by demonstration. This term normally implies proof by comparison.

**whole-fish** -- the entire body of a fish including all internal and external organs, tissue and fluids.